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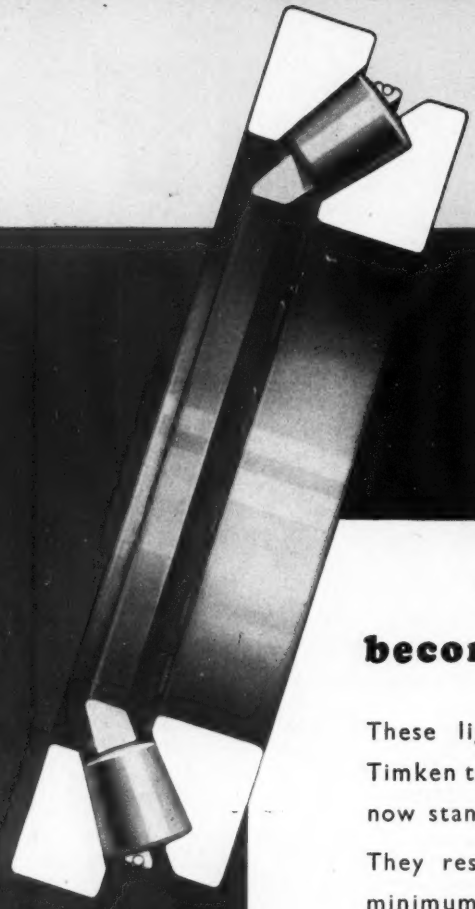

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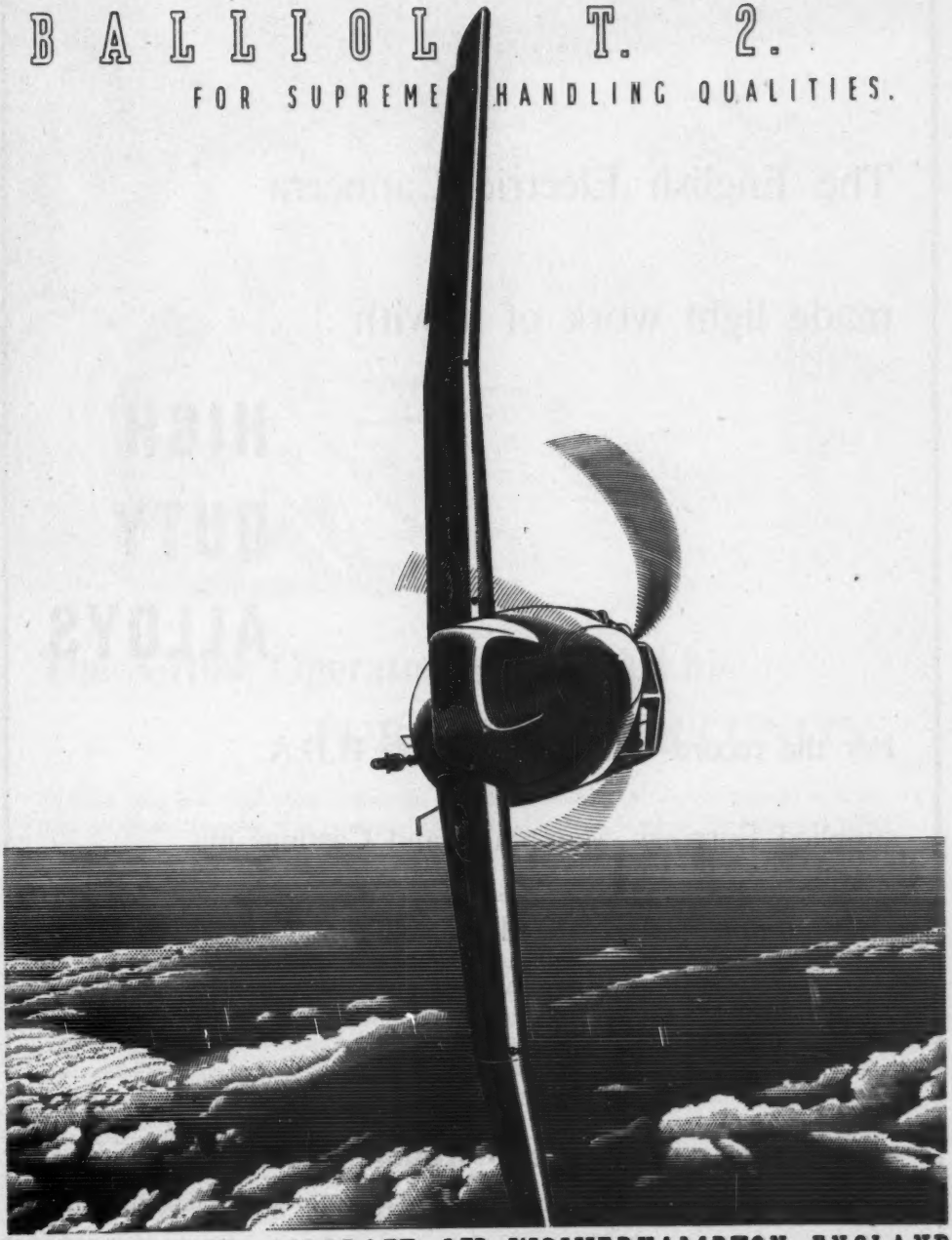

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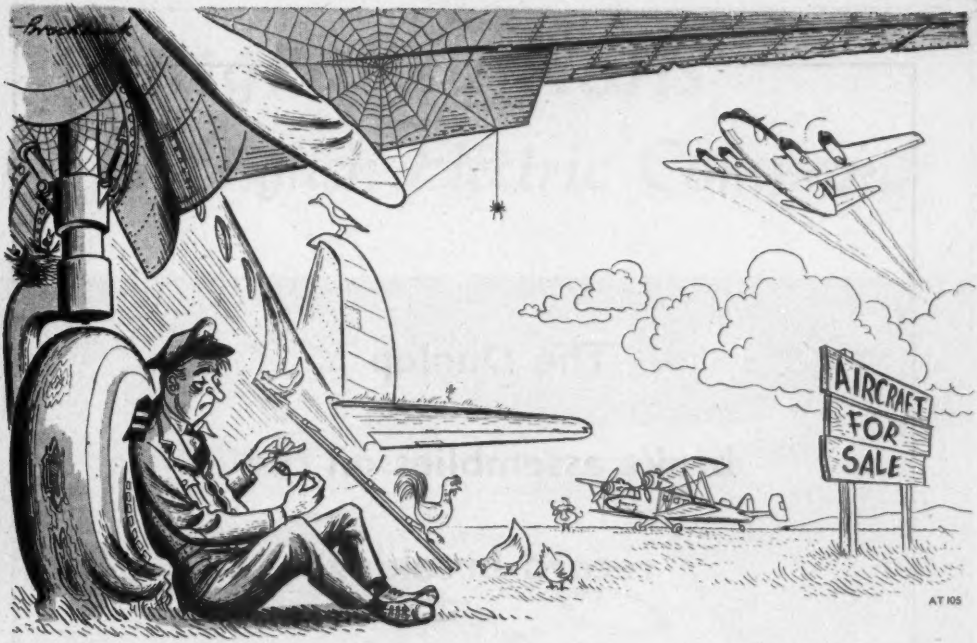

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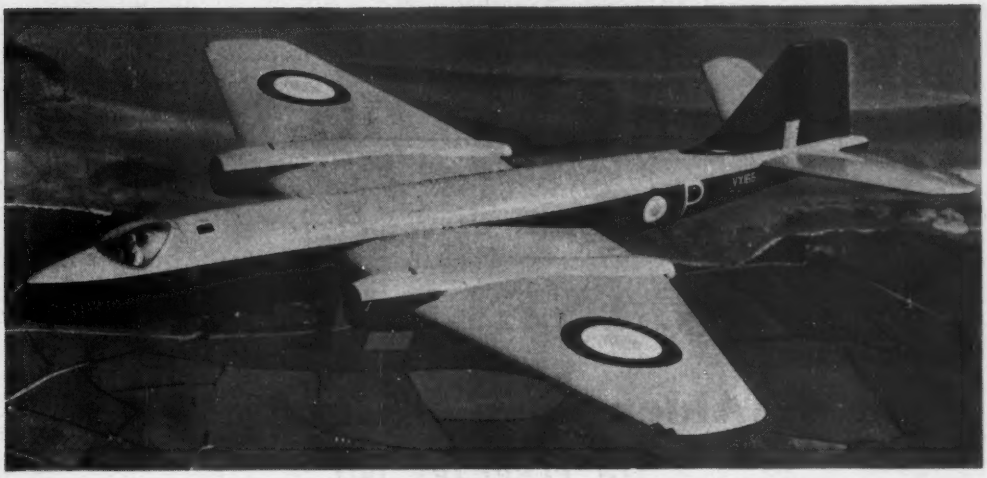

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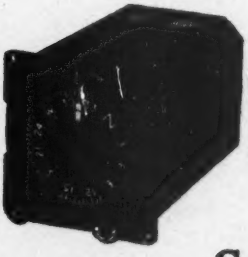

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Canberra—Shows the Way . . .

OF the 2,000-odd issues of *Flight* which have appeared to date, a few command extra-special attention among historians, students and collectors—that, for instance, which records the first direct Atlantic crossing, by Alcock and Brown, and others containing the first serious dissertations on jet propulsion to appear in any aeronautical journal. Among these last were predictions by G. Geoffrey Smith, *Flight's* managing editor, of transatlantic crossings at 500-600 m.p.h—predictions with which Air Commodore Sir Frank Whittle, designer of the first successful turbojet, was in accord.

That the present issue will in due time likewise be prized as a contemporary chronical we have no doubt, recording, as it does, the first direct crossing of the Atlantic Ocean by a jet-propelled aircraft without recourse to flight-refuelling. The flight is the more meritorious in having been made from east to west, in face of the strong opposing winds encountered even at lofty levels where the Canberra cruised.

The English Electric Canberra's performance on February 21st is a resounding vindication of Britain's faith in jet propulsion. In acclaiming those who designed, built and equipped the Avon-powered Canberra, and the R.A.F. crew which manned it, we speak for the whole country. Nor do we forget Sir Frank Whittle.

. . . for Civil Aviation

IT is generally assumed, though not always borne out in fact, that progress with civil aircraft will lag several years behind military developments; but during the last few years—since the war, in fact—certain designs have been conceived, and aircraft built, almost side-by-side for the two widely different spheres of flying. The period must be almost unique in this respect so far as Commonwealth aviation is concerned, producing as it has two four-jet airliners before a bomber counterpart, and no fewer than three turboprop airliners of medium or large size.

Indicative of the overall situation is the description given by M. Maurice Roy in his Louis Bleriot lecture before the R.Ae.S. on February 23rd. He commented that the primary reason for progress in the design of commercial aircraft was the need to use the best power plants with increased performances. Such units became available, thanks to a large and continuous rate of production for military aviation. He also quoted Mr. Harold Adams, who in 1948 said that in the race towards higher speeds the fighter metaphorically tows the commercial aircraft, with a time-lead which grows slowly but which is of the order of six to eight years.

Yesterday's discussions as to whether and when gas turbines would be applicable to civil aircraft have today changed to others upon the traffic-control and navigational problems that will arise when the introduction of such machines becomes fact next year. The Canberra's remarkable achievement last week is but another indication of what can be expected of jet power. Were it to have good cause to do so, there is little doubt that the Comet in its present form could follow the Canberra across the Atlantic.

Although British, Canadian and Irish airlines are the only ones to have ordered turbine-powered airliners to date, others of the world's operators freely admit that they must soon follow suit, though for the time being they prefer to operate conventional, known-quantity, machines while someone else pays for the jet trail-blazing.

The need for jet airliners to begin an accurate let-down from operational height into a congested traffic pattern, or to receive warning of diversion when still over 100 miles from destination—these are the sort of control problems to be faced.

Servicing of turbine-powered aircraft is not expected to cause difficulties—on the contrary; but the increased numbers of passengers carried in larger aircraft with greater frequency of arrivals will necessitate improved services at international airports if delay offsetting the speed advantage of the new airliners is to be avoided.

Of turbojet-powered civil aircraft (and of long-range military machines as well) it may be said that the considerable benefit to fuel consumption expected to follow upon the installation of axial-compressor power units is perhaps the most important single factor influencing their development and subsequent adoption.

CANBERRA ACROSS

R.A.F. Crew Delivers English Electric Jet Bomber to America

(Illustrated with "Flight" Photographs)

The crew: (left to right) F/L. A. J. R. Robson, D.F.C. (signaller), S/L. A. E. Callard, D.F.C. (captain and pilot), F/L. E. A. J. Haskett (navigator).

THE last entry on the departures board in the Flight Planning Section at R.A.F. Station Aldergrove on the morning of February 21st was prosaic enough: it concerned a Hastings routed for St. Eval. But around lunch-time a sergeant took a stick of chalk and added, on the line below, an inscription signifying "Canberra airborne 1243, E.T.A. Gander 1656". He thereby wrote the opening sentence on a new page of Service history.

The flight, by an English Electric Canberra B.2 tactical bomber, with Rolls-Royce Avon turbojets, was the first direct Atlantic crossing by a jet-propelled aircraft without refuelling. As the world now knows, the distance of 2,100 miles was covered in an elapsed time of 4 hr 37 min.

Our own account may well begin on the afternoon of February 19th, when, chilled to numbness, we were huddled at the head of one of the Aldergrove runways, awaiting the Canberra. After delays she was at last signalled as having left the makers' airfield at Warton, Lancs. The sight of her scudding across the massing clouds, with the late afternoon sun glinting on her black and grey surfaces, was counted worth the long deep freeze. After two low runs at a modest 400 m.p.h., she touched down in the gentle manner of her type and taxied in. The airfield rabbits were as wonder-struck as the station personnel and visitors: though well used to the differing notes of Merlins and Hercules, two frightened pairs of bunnies bolted panic-stricken and nearly collided head-on as the Avons revved up for a last tremendous surge of thrust. Something new had arrived.

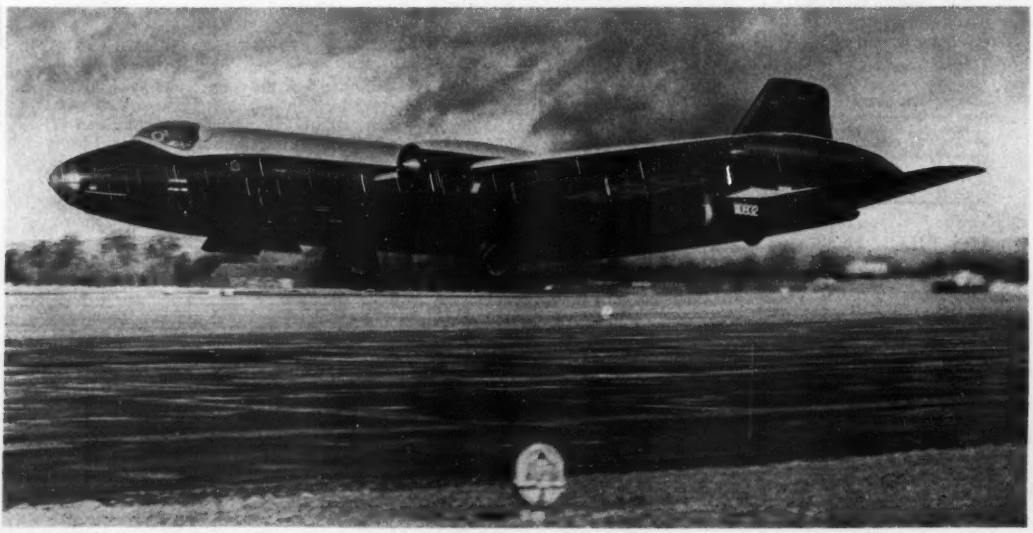
On the tarmac were the Governor of Northern Ireland, Earl Granville; Sir Robert Gransden, representing the Prime Minister; and the station commander, G/C. S. L. Blunt.

From the hatch on the Canberra's starboard side there emerged, after a due period of extrication, the crew—all three from the Aircraft and Armament Experimental Establishment, Boscombe Down. They were S/L. A. E. Callard, D.F.C., captain and pilot (joined R.A.F. 1940, Canada-trained, sometime intruder pilot); F/L. E. A. J. Haskett, navigator (former clerk-accountant, and navigator with 4 Group, Bomber Command); and F/L. A. J. R. Robson, D.F.C., signaller (trained as a "Wop/AG", operational with Bomber and Transport Commands, and present captain of Boscombe Down's baseball team).

The Canberra (on the charge of the Ministry of Supply and not, as reported, the R.A.F.) was serial-numbered WD932 and carried wing-tip and bomb-bay auxiliary tanks, the capacity of which was the object of conjecture on all sides. Neatly stencilled characters marked the position of a camera hatch. One noted the latest cockpit-fairing and revised rudder-form, but nothing appeared abnormal until, from head-on, a hole some six inches across was seen in the starboard leading edge. Someone's assurance that this was a cabin-air intake could not be accepted: certainly its edges did not bespeak English Electric finish. The station C.T.O. approached, inserted his hand, and distastefully withdrew major and minor components of a seagull.

The presence of the remains were soon explained to us by S/L. Callard himself. About three minutes after leaving Warton, in showery weather, he saw a flock of gulls ahead. The Canberra was then clocking about 350 kt. Had the birds, as he put it, pressed on, and not behaved stupidly, all would

The aircraft: With the nosewheels almost retracted and main wheels coming up, the Canberra B.2 is seen on her departure for Gander. The light-coloured strips on the fuselage are the customary inscriptions, giving various warnings and marking the positions of equipment.



The story of a hole: The gull-strike; work under way; the patch and masking.

On the right, S/L. Callard is officially taking over the Canberra from English Electric officials after completion of repairs seen in progress above.

have been well; but, as it happened, one was struck. Callard felt the impact and feared for one of the Avons; Haskett looked out but saw no damage. It was, however (as the Aldergrove C.T.O. soon discovered) serious enough to keep the Canberra grounded throughout the night while repairs were effected. The delay was especially unfortunate as the met. forecast was at that time comparatively favourable. Thereafter conditions were likely to deteriorate.

S/L. Callard handed over to Mr. S. E. Virgo for a more detailed met. briefing. Mr. Virgo is senior meteorological officer of No. 18 Group, R.A.F., and for some time has been specializing in Atlantic forecasting. He gave due credit to the collaboration of the Central Forecasting Office at Dunstable and the staff at Prestwick. He had plotted a special series of charts showing winds and temperatures up to a height of 50,000ft, but the level for the actual crossing was, of course, to be decided by the pilot himself. Mr. Virgo explained that the winds tended to increase with height up to 35,000ft, but that they lessened in force in the stratosphere; so it would pay Callard to fly as high as possible. At 30 deg west and 40,000ft they were of the order of 70-75 kt, 310 deg, but at 50,000ft had dropped to some 45-50 kt—an important difference in 10,000ft of height. These winds, remarked the met. expert, should not change substantially in the immediate future but there was a prospect of worsening conditions at Gander. (The landing forecast, incidentally, was a routine one, passed by radio in the normal way.)

The Canberra was to fly roughly a Great-Circle course and would not employ the pressure-pattern technique. Her track passed near two weather-ships—one British and one American—and F/L. Robson would be able to talk with both. The distance was 1,800 nautical miles (2,100 statute miles), and although S/L. Callard would say nothing which might give a precise measure of the Canberra's performance, he did mention that each increment of 50 kt in wind speed would add about half an hour to his time. There were several convenient diversions, including Bluie West, in Greenland. The usual civil procedure of reporting would be followed, which meant that out into mid-Atlantic the aircraft would be in touch with Prestwick Trans-ocean Control, and thereafter with Gander.

The fuel-transfer system from the wing-tip tanks, we learned, had been checked on the trip over from Warton. At one time Callard expected to jettison these tanks, but calculations by the English Electric technical staff showed that the drag penalty would be negligible, and so he proposed to retain them.

At Gander the aircraft would take on fuel and oxygen before leaving for Andrews Field, near Washington. It transpired that a "small technical job" mentioned by S/L. Callard as being necessary at Gander would be to measure the length of the generator brushes.

The crew were wearing standard pressure waistcoats and the pilot showed us his new "experimental war-service dress" which, if approved, will be generally issued. The blouse and trousers are in blue-grey barathea, the blouse being longer in the waist than the existing war-service dress blouse. The design allows for greater freedom of movement, essential in modern Service aircraft, and elastic at the waist permits

The centre of the three views above shows Mr. S. E. Virgo, senior met. officer, No. 18 Group, with S/L. Callard (in his experimental war-service dress) and F/Ls. Haskett and Robson. The lower picture shows the Canberra being re-fuelled shortly before leaving on February 21st.

CANBERRA ACROSS . . .

expansion over pressure waistcoats. There are two types of trousers, one with long sliding fasteners on the outside seams, which give quick access to the fasteners of the normal flying clothing worn underneath, and the other conforming to the normal pattern. Blouse and trousers have been designed for wear in conjunction with a wide range of protective undergarments.

The "Mae Wests" were of the newest type, as illustrated in *Flight* of January 25th last.

Having been photographed, filmed, interrogated and stalked for autographs, the crew found sanctuary in the mess: there was nothing for it but to await repair of the gull-sabotaged wing.

Soon after daylight on February 21st we were again out at Aldergrove. The night had not passed without incident. Just before 2000 hr Mr. Peter Hillwood, an English Electric test pilot, who had ferried a party over in the firm's Consul, was very wisely making himself comfortable in the mess when word came from the Canberra's hangar that the damage was not wholly superficial. A generator cable in the leading edge had suffered. With his navigator, Mr. D. A. Watson, Hillwood lost no time in getting airborne to collect a spare. It was snowing. Cloud-base over Belfast was at 400ft, tops at 10,000-11,000ft; but the Consul forced through to Warton. On the descent through cloud, severe icing was encountered and one sliver from an airscrew penetrated the fuselage. Having landed, the aircraft was still as iced as a Christmas cake but, with the spare aboard, returned in the frozen darkness without further mutilation. By 0845 repairs were completed in the bitterly cold hangar by R.A.F. and English Electric personnel. These splendid performances were to pass almost unnoticed in the flurry of publicity rightly occasioned by the Canberra's flight.

The "E.E." team at Aldergrove were Mr. D. L. Ellis (deputy chief engineer); H. C. Harrison (chief production designer), R. N. Hollock (aircraft service manager); J. Crowther (foreman); F. Holman (inspector); J. Cookson (electrician); and J. R. Taylor and G. N. Fraser (fitters). Representing Marconi radio interests was W/C. R. R. Stanford Tuck, D.S.O., D.F.C.

Away at Last

At Flight Planning we learned that head-winds were less favourable than the day before, but that Gander conditions were acceptable. S/L. Callard appeared and was badgered into admitting that he hoped the crossing would take "less than five hours," hastening to add that if a G.C.A. landing at Gander were necessary this might add 20 minutes or so to his time. Overnight, the Prime Minister of Northern Ireland, Sir Basil Brooke, had visited the mess and had handed him a letter for the premier of Newfoundland, Mr. J. R. Smallwood. To a last question Callard replied that he would have the Canberra off in about three-quarters of the 2,000-yd runway.

After an engine-run to test the new generator cable, the Canberra was at length refuelled by the overtaxed station bowsers. (Quips about "Callard and Bowser" were severely discouraged.) From a point about two-thirds of the distance down the runway we saw her towed out and positioned. The little flock of votaries dispersed, the firing of the cartridges in the Rolls-Royce turbo-starters was faintly heard, the Avons roared, and the Canberra surged up the wet runway with sheets of spray rising under the blast of the Avons. The nose-wheels lifted, the spray ceased, and before three-quarters of the runway had been used up the wheels were retracting. Callard built up the knots, then eased his beautiful charge into a gentle climbing turn—westwards.

Scant reports from Prestwick and Gander tell that F/L. Robson reported his position at 1206, 1450 and 1530 hr. Head-winds were strong, but by 1649 contact had been made with Gander tower, and the Canberra was on a controlled descent. She made a wide circuit and touched down smoothly at 1720 G.M.T. Average height for the trip had been about 40,000ft, but at one time the machine is believed to have been cruising at 48,000ft.

And so the Atlantic was bridged in little over 4½ hr, and the previous best time for the Ireland-Gander trip (by a Pan American Constellation, in 6 hr 40 min) had been cut by about 2 hr. There is now, of course, much speculation as to the Canberra's speed in the west-east direction, the fastest recorded time for which is 5 hr 10 min, put up by a de Havilland Mosquito during the war.

Congratulations have been flooding in on the crew, the English Electric and Rolls-Royce companies, and—very justly—on Mr. W. E. Petter, the Canberra's designer. Mr. Arthur Henderson, the Air Minister, telegraphed S/L. Callard as follows :—

"*Congratulations to you and your crew on record-breaking flight. The splendid airmanship you have shown proves the quality of R.A.F. prowess in the air and the Canberra has shown that the British aircraft industry stands in the forefront of modern development.*"

On February 24th Callard flew the Canberra on to Andrews Field, near Washington; thence it was to go to the Wright-Patterson Air Force Base, at Dayton, Ohio, where the U.S.A.F. are to initiate a period of evaluation—particularly, it is believed, in the night-intruder role. In America the machine will be serviced by a party of six senior N.C.O.s from the R.A.F. Central Servicing Development Establishment, which draws up schedules for all new R.A.F. machines. Members of the party have been attached to the English Electric company during recent months to familiarize themselves with the Canberra. They have assisted in the Boscombe Down trials and have been responsible for servicing at the various air displays in England and on the Continent at which the Canberra has been demonstrated with such resounding effect. Their names are: F/S. W. C. Slade (electrical fitter); Sgt. S. W. Smith (armament fitter); Sgt. R. A. Pirie (aircraft fitter); Sgt. L. W. Greenwood (aircraft fitter); Sgt. A. Byrom (air radio fitter); and Sgt. A. Hunt (instrument maker).

The 1,317 miles from Gander to Washington was flown in 2 hr 59 min. Waiting officials included Maj.-Gen. Morris R. Nelson, U.S.A.F. Director of Requirements, and A. Cdre. Swain, Deputy Chief of the British Air Force staff in Washington. Late reports from America state that plans are well advanced for Canberra production at the Glenn L. Martin plant in Maryland. The Martin concern has built, and submitted for official tests, prototypes of a high-speed, swept-wing, three-jet bomber—the XB-51—with which the Canberra would be competitive in the tactical troop-support role.

Sharing the credit for the Canberra's achievement with English Electric and Rolls-Royce are the manufacturers listed below.

H.F.K.

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FROM ALL QUARTERS

A French Occasion

THE fourth Louis Bleriot lecture—to commemorate the crossing of the English Channel by the great French pioneer in 1909—was read this year in London before a gathering of members of the Association Française des Ingénieurs et Techniciens de l'Aéronautique and of the Royal Aeronautical Society, their hosts for the occasion. The lecture room of the Institution of Civil Engineers was the venue, on the evening of Friday last.

Entitled *Power versus Weight in Aviation*, the paper was the work of M. Maurice Roy, and was read in English by Commandant G. de Fraget, Chief of the Overseas Relations (Documentation) Section of the Office National d'Études et des Recherches Aéronautiques. In it M. Roy compared the inter-relation of power and weight from the earliest days of aviation and then went on to discuss modern design-tendencies, particularly with reference to supersonic aircraft. We shall summarize the paper next week.

M. Roy is an authority on gas turbines. As early as 1928 he outlined their future in aviation, and in the following year presented a "general theory of jets" in which he clearly expounded theories on which present-day practice is based. For the next ten years he was a lecturer in aviation mechanics at the École National Supérieur de l'Aéronautique and, in 1949, was appointed Director of O.N.E.R.A.

At the conclusion of his paper M. Roy was thanked, on behalf of the R.Ae.S., by Dr. Roxbee Cox, who remarked that as a member of the Academie Française and "therefore himself an immortal", M. Roy was well qualified to do justice to Louis Bleriot.

Spanish Airports Programme

THE acquisition by the Spanish Government of a U.S. Export-Import Bank loan amounting to about $5,000,000 (£1,800,000) —to be used for the modernization of civil airfields—is now being discussed in Washington. The U.S. Government is understood to be anxious that Spain's commercial air-transport facilities should be adequately developed. The programme would include the provision of adequate airfield radar and landing aids, and would also involve increases in the size and strength of runways at several airports.

The Spanish Government is also known to be interested in acquiring a number of modern commercial aircraft for use between Spain, the Caribbean, Miami, Mexico and Venezuela.

Sir Arthur Street

THOUGH he left the Air Ministry over five years ago, Sir Arthur Street, G.C.B., M.C., J.P., who died suddenly in London last Saturday at the age of 58, will long be remembered by all who worked there with him. Joining the Ministry in 1938 as Deputy Secretary, he was shortly afterwards appointed Permanent Under Secretary, a post which he occupied until the end of the war; he was also Secretary of the Air Council. After the war he was Permanent Secretary to the Control Office for Germany and Austria for a short period before being appointed, in 1946, Deputy Chairman of the National Coal Board, a post he occupied to the end. In the First World War he had served with distinction in the Army; and in 1919, as a civilian once more, he went to the Admiralty, where he was P.P.S. to the First Lord. During the inter-war years, as Second Secretary at the Ministry of Agriculture, he earned the reputation of being "the man who saved English agriculture"; the National Mark food scheme was his.

Sir Arthur Street

Most of the obituary notices over the week-end have implied that his death was a more or less direct outcome of his devotion to duty; that this should be so will be no surprise to those who saw him at work in the Air Ministry during the war. By their phenomenal capacity for work senior civil servants under any and every British Government have always disproved the popular fallacy, and Sir Arthur Street was a supreme example. From early morning to late at night throughout the dark and often dangerous years he was in his office; and many an R.A.F. officer, from the most junior rank to the C.A.S. himself, had cause to be grateful to this quiet, imperturbable civilian for his deep insight, good judgment and unfailing willingness to resolve the formidable problems, the war-time conflicts between Service and civil interests.

Sir Arthur bore with fortitude the loss of one of his two sons, in particularly tragic circumstances; young Street was among the R.A.F. officers murdered by the Germans in Stalag Luft III.

The president of A.F.I.T.A., M. Jarry, presents the Medaille de l'Aéronautique to Capt. Laurence Pritchard, as related below.

New R.Ae.S. Secretary

THE delivery of the Louis Bleriot Lecture to the Royal Aeronautical Society last Friday—referred to elsewhere on this page—was also made the occasion of a presentation to the Society's retiring secretary, Capt. Laurence Pritchard.

On behalf of A.F.I.T.A. (the French counterpart of the R.Ae.S.) M. Jarry, its president, presented to Capt. Pritchard, with traditional ceremony, the Medaille de l'Aéronautique for his "services to French aviation". In particular, as M. Jarry pointed out, the award recognized the great part which Capt. Pritchard had played during the past five years in fostering the friendship and co-operation between the two learned societies. This was the first occasion on which the distinction had been conferred in England.

The award was followed by an announcement by the R.Ae.S. president, G. P. Bulman, C.B.E., F.R.Ae.S., of the forthcoming appointment of Capt. Pritchard's successor. The new secretary is to be Dr. A. M. Ballantyne, Ph.D., A.F.R.Ae.S., A.M.I.C.E., A.M.I.Struct.E., who at present is senior lecturer in the Civil and Municipal Engineering Department at the University of London. Dr. Ballantyne is expected to take up his new duties in June or July.

Party With A Purpose

CHIEF among many reasons for satisfaction occasioned by the Royal Air Force Reserves Club's second annual ball, at Grosvenor House on Saturday last, was a prediction by the Club's president, Air Chief Marshal Sir Guy Garrod, that the evening's merriment would mean a cheque for the R.A.F. Benevolent Fund even fatter than last year's — and that was for £1,052. Most honoured and most welcome of the guests were Lord and Lady Trenchard. Jimmy Edwards and Jack and Daphne Barker (surely the best possible entertainers for such an occasion) were on tip-top form—Jimmy in his capacity as auctioneer. Autographed copies of three best-sellers on R.A.F. escapology fetched Sotheby prices, and the famous bottle of whisky, signed by a bomber crew before their last sortie, raised £30.

As Sir Guy Garrod observed in his message in the souvenir programme (by the selling of which a selection of London's most pulchritudinous mannequins painlessly extracted a worthy sum) the ball provides an opportunity for its members to get together with other Air Force organizations and with the aircraft firms.

FORTHCOMING EVENTS

Mar.	3.	British Interplanetary Society: "Combustion in the Rocket Motor," by Prof. A. D. Baxter, M.Eng., A.M.I.Mech.E., A.F.R.Ae.S.
Mar.	3.	Royal Navy *v.* Army Rugby, Twickenham.
Mar.	5.	Institute of Transport: "Air Transport by Charter Companies," by Capt. R. J. Ashley.
Mar.	7.	Royal United Service Institution: "The Campaign in Malaya," by A.V.M. Sir Francis Mellersh, K.B.E., A.F.C.
Mar.	15.	R.Ae.S.: "Towards Hydraulic Serviceability," by H. G. Conway, M.A., M.I.Mech.E., F.R.Ae.S., and R. H. Bound, F.R.Ae.S.
Mar.	17.	Helicopter Association: "Convertible Aircraft," by Capt. R. N. Liptrot, C.B.E., B.A.

HERE AND THERE

CHECKERED: The decoration on the swept-back fins of this Chance-Vought F7U-3 Cutlass tail-less carrier-borne fighter gives warning that the aircraft is on test. The Cutlass, seen here to have acquired extra fin-area, is in limited production for the U.S. Navy.

Atomic Aircraft Engine

FOR the past four years, the Fairchild company has been working on Project N.E.P.A. (nuclear energy for the propulsion of aircraft) at the Oakridge, Tennessee, plant of the American Atomic Energy Commission. The cost of the project has been shared by the U.S.A.F. and Navy Bureau of Aeronautics.

A turning-point in these initial experiments was reached on April 30th, when it was announced that "sufficient progress has been made with the theoretical study of aircraft propelled by nuclear energy for . . . construction of an experimental engine." Subject to the completion of negotiations now in progress, the constructor of the first nuclear unit is expected to be the General Electric Company, a prominent manufacturer of aircraft turbojets.

Every Mod. Con (vair)

EQUIPMENT has been developed to alleviate crew-fatigue during 30-40 hour flights in the huge Convair B-36 bombers of the U.S.A.F. These aircraft will soon be fitted with lightweight retractable tables and folding chairs for meals; large galleys with electric burners and ice-box; rest bunks in the forward pressurized compartment with mattress, pillow and blankets; and new lavatories with hot water, wash-basins and shaving mirrors.

YOUR COPY OF "FLIGHT"

INCREASED demand for *Flight* in its new, improved format, in conjunction with a threatened deterioration in the paper-supply situation, may mean disappointment to readers who rely on purchasing their copies casually. An order placed with a newsagent, or a postal subscription, will ensure regular receipt of each week's issue.

Student-pilot

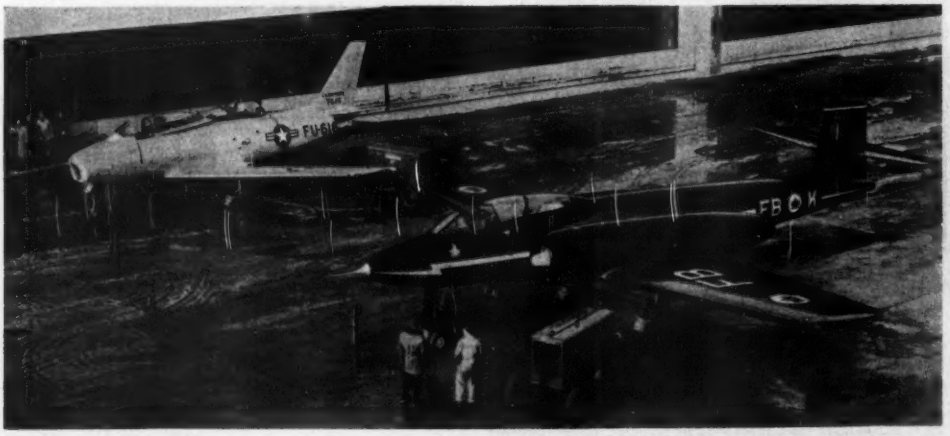
ONE of the students at a recent three-week industrial course at the School of Gas Turbine Technology, Mr. D. D. Budworth, flew daily from his home in Essex to the school in his private aircraft, a Hirtenberg H.S.9A. He flew to and from Blackbushe, the nearest civil airport to Farnborough. Mr. Budworth, who is the managing director of a Harwich firm of ship-builders, took the course to familiarize himself with the latest developments in marine gas turbines.

His aircraft, which was built in Austria in 1936, was flown by D. Robertson in last year's *Daily Express* race on behalf of the previous owner, J. H. Davis.

Spotlight on the Mig

THESE on-the-spot comments on Korean Communist operation of the Mig-15 jet fighter are extracted, with acknowledgements, from a report in *Aviation Week*, by A. W. Jessup. The Mig-15 stands out in speed, climb and "ability to take a beating." Its top speed is "rated well above 600 knots" and sea-level rate of climb is estimated at 8,000ft/min. The apparently high rate of acceleration is probably "accounted for by an afterburner to the Nene or Nene-type engine with which the Mig is supposed to be equipped." Armament is reported to be one 37 mm and two 23 mm guns, all located beneath the lower lip of the air-intake.

Jessup reports that American pilots have "completely outflown and outmanoeuvred whoever flies the Mig," and speculates on the nationality of the Communist pilots, commonly thought to be Chinese or



DEFENSIVE TEAM: Pictured together for the first time are the two aircraft chosen by Canada for interception duties by day or night and in bad weather. On the left is a North American F-86A Sabre (the actual aircraft shown holds the world's speed record of 670.981 m.p.h.), and its larger companion is a prototype Avro Canada Canuck all-weather fighter. Canadair, Ltd., is now producing, under licence, the latest F-86E Sabres.

Although Type 171 is the first "Bristol" helicopter, an unexcelled record of forty years of aeronautical experience is the background to its design and construction.

A Dart turbo-propeller engine being installed in the nose of a Lancaster at the Rolls-Royce Flight Development Establishment. Esso Aviation fuels and lubricants are supplied to all the major British Aircraft and Aero Engine manufacturers.

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HERE AND THERE . . .

Russian. A third theory is put forward: "F-86 pilots who flew against the Germans are convinced that the tactics used by the Mig pilots are identical with those used by the Luftwaffe . . ."

Meteoric Photography

MANY readers will remember a remarkable photograph, by Russell Adams of the Gloster Aircraft Company, of a Meteor 8 pulling out of a loop; the photographer worked from a Meteor 7, piloted by Jan Zurakowski. First published in *Flight* (on March 9th, 1950) the picture was subsequently reproduced by nearly 200 papers in the United States. (It was also, incidentally, the subject of a controversy in our own correspondence columns.) Mr. Adams, who has specialized in "Meteoric" studies, gives an insight into his work in an illustrated article in the February 21st issue of our associated journal *Amateur Photographer*.

PUZZLE PICTURE: Packages, parachutes, static lines and a crazy quiltwork of snow-covered fields. This odd impression was obtained from the open rear hatch of a Fairchild Packet transport during a supply-drop over Korea.

Letting-Down Lightly

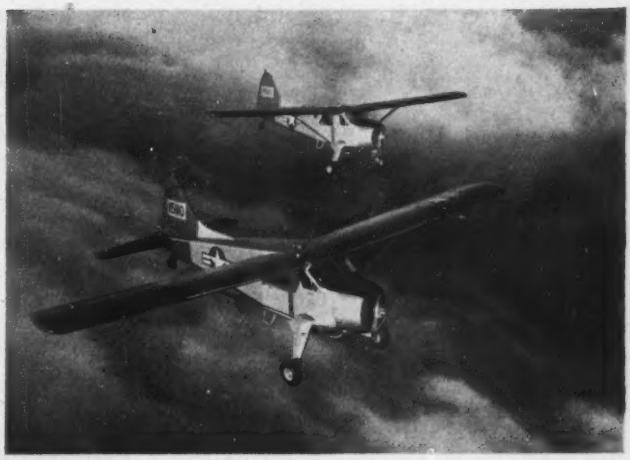
FROM the February issue of the *de Havilland Gazette* comes this example of dry aircrew humour. It sounds too good to be untrue:—

Gander tower to tired Atlantic captain: "Your landing is being filmed by the *No Highway* production unit."

Tired Atlantic captain: "Roger. I'll go round again and part my hair."

U.S. Engine Production

ELEVEN leading American car manufacturers are expected to go into production with aircraft power-units. Two British-designed turbojets, for which American companies have obtained manufacturing licences, play their part in the production programme. Buick will build the J-65, Curtiss-Wright version of the Armstrong Siddeley Sapphire; the J-48, a Pratt and Whitney development of the Rolls-Royce Tay, will be produced by Chrysler. Both of the British units are also being manufactured by the licensed aircraft-engine manufacturers.



EAGER BEAVERS: Fully prepared for liaison and rescue work in northern latitudes, these Beavers have been delivered to the U.S.A.F. from the de Havilland company of Canada. Special nose-cowlings have been fitted, and other modifications made for cold-weather operation. The American designation is YL-20-DH.

IN BRIEF

THE Physical Society's exhibition is to be held from April 6th to 10th, at the Imperial College, South Kensington, London, S.W.7. Tickets are obtainable from the secretary, at 1, Lowther Gardens, Prince Consort Road, London, S.W.7.

* * *

V.H.F. radio equipment made by the General Electric Co., Ltd., has been installed in the air/sea rescue launches now being operated by the St. John Ambulance Brigade in Guernsey.

* * *

Your Weather Service is the title of a booklet which, issued by the Meteorological Office, explains in a concise non-technical style the work of weather forecasting and the methods by which the results are presented to the public. It is obtainable from H.M. Stationery Office at 1s.

* * *

Illustrated with particularly clear drawings, a new service manual has been published by the aviation products department of the Goodyear Tyre and Rubber Co. (G.B.), Ltd., Wolverhampton; it deals with tyres, tubes, wheel and brake equipment and the cross-wind landing gear.

* * *

A loose-leaf maintenance manual of Avica flexible-pipe assemblies was issued in 1949, and a second edition, based on experience accumulated in the interim, has now been published. It is obtainable by executives on application to Avica Equipment, Ltd., 50, Pall Mall, London, S.W.1, while sets of servicing instructions are available for maintenance engineers and students.

* * *

Air-Britain (an association of aviation enthusiasts, with branches overseas) has issued a statement to the effect that two of its members involved in the recent military-aircraft security case have been expelled from the association. They add that, though one of the three defendants was originally their secretary, he "has had no contact with them for three years."

BRISTOL-BOEING: At Seattle recently, Mr. C. F. Uwins (right), managing direction of the Bristol Aeroplane Company's aircraft division, signed an agreement for technical collaboration with the Boeing Airplane Company. The two companies will exchange data on certain undisclosed defence projects. Witnessing Mr. Uwins' signature are Mr. A. J. Hunt (left), Bristol commercial services manager, and (centre) Mr. W. E. Beall, Boeing vice-president of engineering and sales.

CIVIL AVIATION

THE public inquiry into the accident in which B.E.A's Viking, G-AHPN, crashed in fog at London Airport on October 21st with a loss of 28 lives, opened in London on February 19th. Sir Walter Monckton, K.C., M.P., presided, and the Attorney-General, Sir Hartley Shawcross, attended to represent the Crown.

Describing the crash as "a very strange incident indeed", the Attorney-General read the last recorded messages which passed between the aircraft and the London G.C.A. unit before the aircraft struck the ground. It was stated that although the Viking descended, in breach of the relevant regulations, to within 140ft of the ground in conditions of 30-yd visibility, the captain apparently decided not to attempt to land, but to carry out overshoot procedure. "Although the pilot," said Sir Hartley, "should have been able to do this without any special difficulty, then climb to a safe height and divert, the aircraft apparently struck the runway with undercarriage retracted." Talk-down control was broken off when the aircraft reached 140ft and the pilot then had another 16 seconds before actually touching down. During this time he was supposed to have been in visual contact with the ground and to have been making his final adjustments to land.

Mr. Roger Winn, for B.E.A., disagreed with Sir Hartley over the interpretation of certain regulations. He said that, in practice, Sir Hartley's understanding of them (to the effect that pilots should not continue flying towards an airfield at which weather minima had been exceeded) was not understood by operators and pilots in any such sense. They interpreted it as meaning that they should not go beyond a "break-off height" if conditions deteriorated below the prescribed minima.

On February 21st Sir Walter Monckton flew in an M.C.A. Dove which simulated the Viking's approach. At the resumed hearing on February 22nd, recordings of the final conversation between the Viking pilot, Capt. S. D. Clayton, and the G.C.A. controller, were played-back to the court.

S.A.A. "COACH" SERVICES

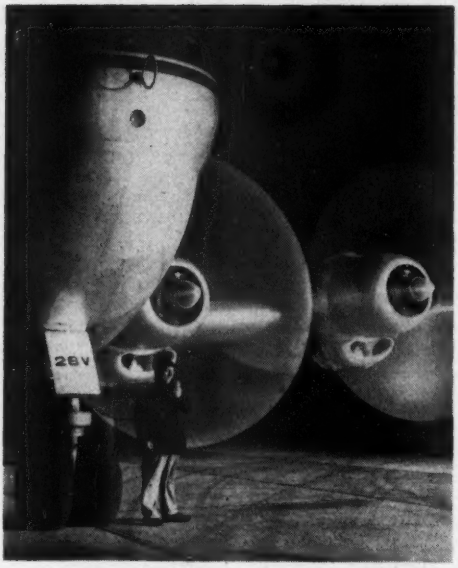
SOUTH AFRICAN AIRWAYS have notified I.A.T.A. of their intention to start cheap-fare "air coach" services, using Skymasters, on the route between London and Johannesburg early next year. Before such a service can be introduced approval must be obtained from I.A.T.A. and from interested airlines with whom S.A.A. have route agreements.

This new tourist-class service will be run in addition to the normal flights by the company's Constellations and by B.O.A.C's Hermes. Initial frequency will be once weekly and the 52-seat Skymasters are, in fact, the aircraft which, until replaced by Constellations last year, were providing first-class services on this route. The single fare will be 22½ per cent less than the present first-class rate, i.e., £120 instead of £167. Return fare will be £234 as compared with £312 12s. Meals for passengers will be provided at stopping points wherever possible, but otherwise boxed lunches will be served in the air. The route through Africa will be from Johannesburg *via* Salisbury, Nairobi, Juba, Khartoum and Cairo or Castel Benito.

Other airlines are known to have studied the possibility of similar tourist-class services for some time and it is believed that B.O.A.C. contemplate a similar plan for their Bristol 175s.

From South Africa, also, comes news of progress in building all-weather airfields which would be of strategic importance in time of emergency. In Capetown recently the Minister of Transport said it was now believed that one hardened runway and one consolidated grass-covered runway were all that was necessary for each airfield for the present. A useful aspect was, he said, that more airports could be built with the funds available and in a shorter time. The order of priority for the work in hand is: Port Elizabeth, East London, Windhoek and Bloemfontein. Steady progress is also reported in the work at the Jan Smuts international airport at Belville, Capetown.

A re-shuffle of airports on the Rand is also to take place during the next few years. The present Rand Airport at Germiston is to be closed to make room for a new suburb, while the international airport of Palmietfontein is to be taken over from its owners, South African Railways, by the Johannesburg Municipality. It will then be known as the Rand Airport. The Railways, also responsible for constructing the Jan Smuts Airport, may soon relinquish their control in favour of the Department of Transport.



NIGHT EFFECT: A striking study from Idlewild Airport, as a Pan-American Stratocruiser's 14,000 horses are called into action before a night take-off. The crew chief checks start-ups over the inter-phone.

SOUTH PACIFIC SURVEY

THE well-known Australian pilot, Capt. P. G. Taylor, G.C., M.C., is shortly to undertake a survey flight, using a Catalina, of the hazardous 8,000-mile route across the South Pacific between Australia and Chile. This will be the first time that the flight has been made. The longest stage will be one of nearly 2,000 miles, between Easter Island and Valparaiso, Chile.

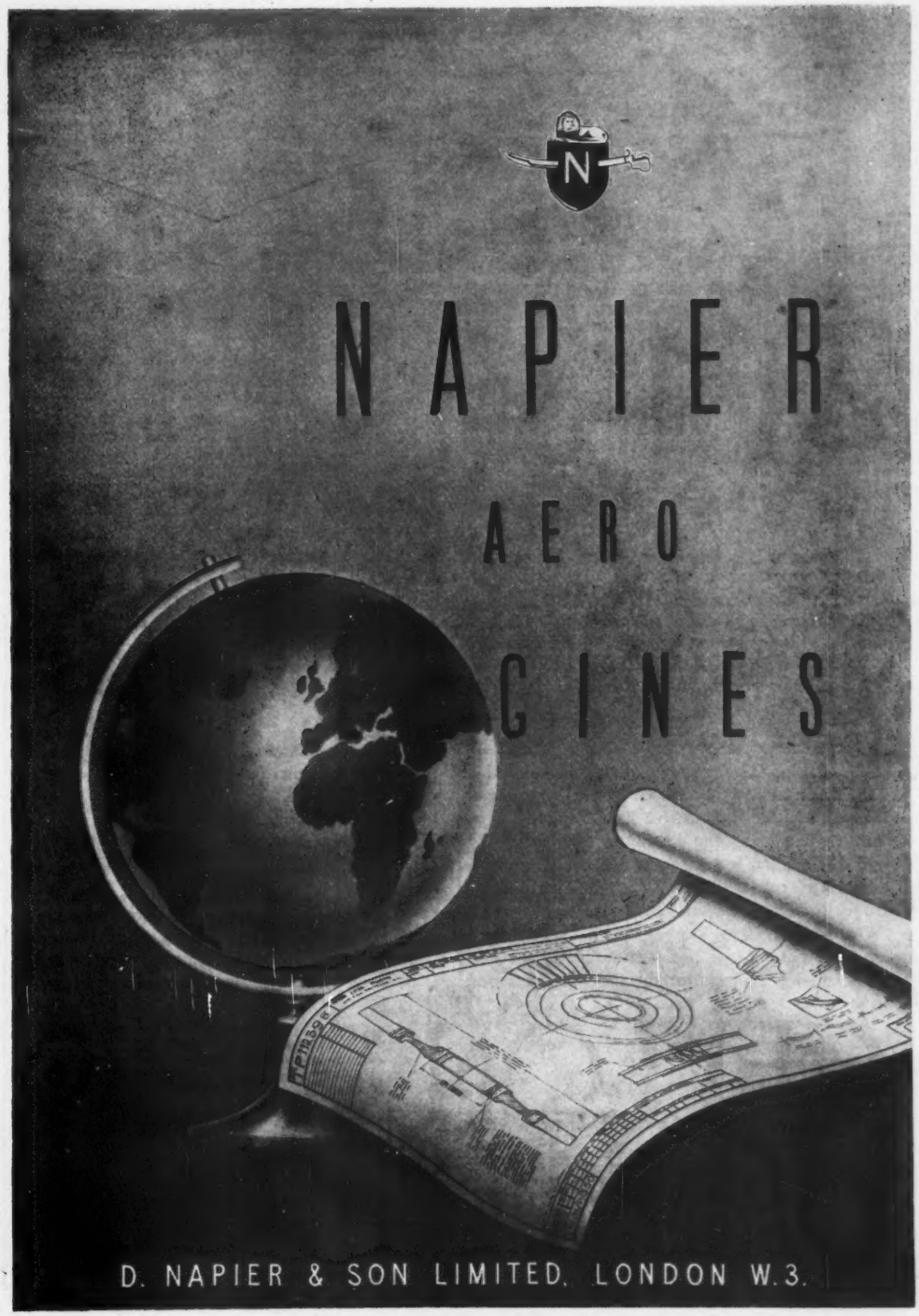
Captain P. G. Taylor, G.C., M.C.

The survey is being undertaken to assess the possibilities of establishing a trans-Pacific route to South America. The exact departure date has not yet been fixed, but the aircraft will leave as soon as plans are completed. The Catalina, a type noted during the last war for its long-range capabilities, will carry a crew of six on the survey flight.

Capt. Taylor has already made two flights of a similar nature in Catalinas. In 1939 he flew from Western Australia to East Africa to survey a route for a direct service between those two areas and, in 1944, he flew from Acapulco, Mexico, to Australia *via* Tahiti, to survey a Central Pacific route.

On the forthcoming flight he will fly by way of Suva (Fiji), Aitutaki (Cook Islands), Tahiti (Society Islands), Mangareva (Gambier group) and Easter Island. From Valparaiso the aircraft may go on to Rio de Janeiro and Buenos Aires.

The crossing is expected to take about a fortnight and the round trip approximately six weeks. Capt. Taylor has said, however, that if and when an airline inaugurates the South Pacific run, three days would be a reasonable estimate of elapsed time for the crossing. During his survey he will seek sheltered landing bases and examine their facilities for radio control installations and passenger and crew accommodation; he also hopes to gain useful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CIVIL AVIATION NEWS . . .

experience of the weather conditions peculiar to the Pacific route, Capt. Taylor considers that, while the crossing can be made by landplanes, flying-boats have shown by their development in recent years that they may be eventually more suitable for long-range ocean routes. Their use would also, of course, eliminate the need for the construction and maintenance of coral landing strips, in itself a particularly expensive item.

In 1933 Capt. Taylor performed a remarkable feat when, as navigator to Sir Charles Kingsford-Smith, whose F.VIIb-3m (the *Southern Cross*) was crossing the Tasman Sea, he climbed along the wing to an outboard engine (whose airscrew had broken) in order to obtain oil from its tank, so that he could replenish another engine that was running dry. By extreme bravery he thus averted what would otherwise have meant disaster.

AIR FRANCE SUMMER PLANS

UNDER Air France's newly published summer timetable, which will take effect from April 15th, services on the London-Paris route will be flown approximately every two hours during the day. The popular "Epicurean" flights are being increased to three times daily to enable them to be made the starting flights on through services to the Riviera and Barcelona. From April 16th, 33-seat Languedocs will be introduced on the Paris-Manchester-Glasgow service, while DC-3s are being used on the route from Paris to Manchester, via Birmingham.

Excursion fares from these British provincial centres to Paris are being offered at greatly reduced rates, so that passengers from the Midlands and the North will no longer need to make their way to London to take advantage of the £10 "off-peak" fares. In fact, it will now be cheaper for them to fly direct to Paris from the Provinces.

Air France is also starting, on May 10th, a new four-engined night service from London to Nice, the return fare for which is as low as £25.

PANAGRA'S FASTER DC-6S

PAN AMERICAN-GRACE AIRWAYS, a subsidiary of P.A.W.A. engaged on extensive operations to South America, have begun work on modernizing and improving their fleet of DC-6s; the cost will be more than $500,000. The improvements involve conversion of the Pratt and Witney R.2,800 C.A.15 engines now installed to CB-16s and the fitting of Hamilton Standard (reversible-pitch) airscrews, which will give better climb and cruising characteristics together with improved performance at high altitude.

Panagra's DC-6s will now have an extra 300 h.p. per engine available during take-off, while the additional 100 h.p. per engine at cruising settings will make the aircraft 15 m.p.h. faster. The jet-type exhaust stacks which the airline has fitted since 1947 will continue to be used to provide some measure of thrust augmentation. In addition, to increase engine reliability, ignition systems are to be changed from high to low tension.

The programme is expected to result in improved schedule reliability and reduced maintenance costs and, the company believes, will give Panagra the fastest DC-6s in the world.

AN AIRLINE DE-NATIONALIZED

WITH the acceptance of a tender by Straight's Air Freight Express, Ltd., to operate a cargo service between the North and South Islands, the New Zealand Government has now taken the first step towards de-nationalizing its State-controlled airlines.

The new company, which will use Bristol Freighters, has a New Zealand directorate and is backed financially by Airwork, Ltd., of London. Until now the railway authorities had operated the service between the islands, using Dakotas.

Meanwhile, the New Zealand Labour Party, which was displaced in the 1949 elections, has announced its intention—"when re-elected"—of purchasing at cost-plus-improvement price any airlines disposed of privately.

THE CYCLOPE-PALAS

FOLLOWING the successful trials of the French Fouga Cyclope—the fully aerobatic trainer version of the Piméné-powered Sylphe III jet-propelled sailplane the Fouga factory has now developed a further prototype, known as the Cyclope-Palas. It has a more powerful jet unit—the Turbomeca Palas—of 150 kg static thrust, which has led to notable improvements in performance.

Piloted by M. Léon Bourrieau, the prototype made its first flight on January 31st. The leading statistics of the Cyclope-Palas, shown for comparison with those of the Sylphe I (powered by the Turbomeca TR.011) are as follows :—

	Cyclope-Palas	Sylphe I
Max. static thrust	150 kg	90 kg
Weight of power unit	61·4 kg	54 kg
Span	8·76 m	13·1 m
Area	9·8 m²	13 m²
Basic equipped weight	415 kg	365 kg
All-up-weight	615 kg	525 kg
Max. speed at 4,000 m	350 km/hr	250 km/hr
Climb from sea level	7·5 m/sec	3·5 m/sec
Radius of action in still air	400 km	230 km

The greatly improved performance figures have been achieved mainly through the increased power which is now available, but also, as the table shows, by a considerable reduction in wing-area. Comparative wing-loadings are 63 kg/m² for the Cyclope, as compared with 40.5 for the Sylphe I, while power loadings have been improved from 5.85 kg/kg thrust to 4.1 kg/kg in the Palas.

BREVITIES

THE M.C.A. has sent a radio and radar specialist to inspect the facilities at Australian airports which will be used by the Comet later this year. It is understood that there is already sufficient equipment at the airports likely to be used—Darwin, Cloncurry, Sydney and Melbourne.

* * *

Passengers who, in the past, have felt the inadequacy of the "Continental" breakfasts and 5 o'clock snacks served on Air France services will be glad to hear that, henceforth, full complimentary meals are being provided on the London-Paris services at breakfast and tea-time.

* * *

The Lord Provost of Edinburgh has signified his intention of making a formal complaint to B.E.A. about the way in which, he alleges, the development of Turnhouse airport at Edinburgh is being "deliberately stifled." Authorities in Edinburgh consider that the Corporation's aircraft flying between Renfrew and London should touch down at Turnhouse; at present passengers for London must travel to Renfrew by road.

* * *

Beginning today, March 2nd, two of B.O.A.C.'s *Argonaut* services to the Middle East will call at Zurich. This will be the first time that the Corporation has operated through Switzerland The Bahrein service, which leaves London on Fridays, will fly *via* Zurich, Rome, Damascus and Kuwait; elapsed time will be 21 hours. The Saturday services from London to Cairo, which will take 12 hours, will stop at Zurich and Rome.

According to the Australian Air Minister, Mr. T. W. White, the air service across the Indian Ocean to South Africa is expected to be in operation this year. Progress is reported in negotiations to use the Cocos Islands as an intermediate stop. (Their use for this purpose was advocated in a *Flight* article a year ago.)

* * *

The inauguration by B.E.A. of night mail services between Manchester and Belfast, will according to the G.P.O., enable large quantities of first- and second-class letter mail—now carried by sea—to reach its destination up to 24 hours earlier. On the same date, also, Aer Lingus will start a similar service between Dublin and Manchester.

* * *

Aer Lingus have announced that their service between Dublin and Bristol will be resumed from May 3rd. Initial frequency will be thrice weekly, increasing to four times weekly in July and becoming daily (with the exception of Sundays) in August and September. This pre-war service was cancelled on the outbreak of war in 1939.

* * *

On behalf of the Government of Fiji, the Crown Agents for the Colonies have awarded a contract for the aerial mapping of the island to Hunting Aerosurveys, Ltd. The total area to be photographed is 6,477 square miles, and to reach their operational base the photographic aircraft—a Percival Survey Prince—will fly some 14,500 miles, *via* the Mediterranean, India and Australia. The

CIVIL AVIATION NEWS . . .

preparation of accurate maps which the survey will make possible will assist the development of Fijian projects in connection with road construction, water supplies, land-drainage and power schemes, and geological and soil surveys.

* * *

Two directors of Channel Islands Air Services, Ltd., appeared at Bow Street recently to answer summonses, under the Air Corporations Act of 1949, alleging that they had unlawfully carried passengers between Gatwick, Jersey and Guernsey during August last year. The case was adjourned until March 13th.

* * *

Work on the construction of London Airport has now reached the stage where the present instrument runway, No. 1, is to be taken out of service, and No. 5 runway brought into use. This is located on the south side of the airport, parallel to No. 1, so that the instrument direction, 100 deg to 280 deg magnetic, remains unchanged.

* * *

Proposed improvements this year at the Oakland Municipal Airport, California, will cost more than $2 million; they include a new passenger terminal. The Oakland Board of Port Commissioners has asked the U.S. Government to supply 54 per cent of the funds under the Federal Airport Aid Act. The Board will provide the remaining 46 per cent.

* * *

An interline agreement has been concluded between El Al (the Israeli national airline) and P.A.W.A., by which the former company will make connections between New York and Lydda with Pan American flights at London, Paris, Rome and Istanbul. Both airlines will issue through passenger tickets and cargo waybills. El Al will start Constellation services between New York and Lydda this spring. On March 7th, incidentally, P.A.W.A. will substitute Stratocruisers for DC-4s on the route between the Pacific coast to Sydney, *via* Hawaii. Elapsed time will be reduced by 9 hours.

* * *

Last week B.E.A.'s first Pionair took part in a demonstration tour of some of Britain's major internal airports, including Jersey, Liverpool and Glasgow.

* * *

United Air Lines began their "silver jubilee" year with the best January traffic in the company's history. Revenue passenger-mileage amounted to over 124,000,000, a gain of 55 per cent over the total for the corresponding month of last year.

* * *

In a recent paragraph in these pages it was mentioned that the Goodyear undercarriage costs approximately £1,800. This referred, of course, to the type of installation suitable for large transports. In the case of light aircraft, such as Austers, cross-wind landing gear is available for as little as £180.

* * *

The Belgian airline, Sabena, is expecting to profit considerably from a large influx of tourists to Brussels during the visit of the Viennese Opera Company to that city from March 4th to 9th. The airline serves 61 major cities throughout the world, so that music-lovers in many countries will have the chance to attend one of the four concerts being given.

* * *

Seaboard and Western Airlines, registered as an American irregular international carrier specializing in bulk cargoes, report that 1950 east- and west-bound Atlantic traffic almost balanced, for the first time in nearly four years. In the last quarter of 1950, westbound import traffic actually exceeded that travelling in the opposite direction and for the entire year was 32 per cent higher than in 1949. In the full year, also, the airline flew more than 3,500,000 ton-miles across the Atlantic.

FROM THE CLUBS

MANY British pilots should be attracted to the rally which is being organized this year by the Foire de Paris—an international trade fair now being held for the 47th year. The venue will be Toussus-le-Noble and the event will take place during the first week-end in May. Entries will be limited to 50 pilots of all nations, flying light aircraft with engines not exceeding 450 h.p.; all foreign competitors must be in a position to reach Toussus-le-Noble within two days of leaving their home airfields.

On arrival all participants will be the guests of the Foire de Paris from Sunday, May 6th until the morning of Tuesday, May 8th. Prizes of £75, £50 and £25 respectively will be awarded to the three winning competitors in an arrival competition. Points awarded will take into consideration the distance covered to the rally, but a penalty of 10 per cent will be subtracted from the total for every quarter of an hour for which an aircraft is overdue at the airport after 2 p.m. on May 6th. The official reception will be held on the Sunday.

Entries must reach the Aéro-Club de France at 6, Rue Galilée, Paris (16e), by March 21st. Entry forms may be obtained from the London offices of the Foire de Paris, 4, Park Lane, London, W.1, and an entrance fee of 5,000 fr is being charged; these fees, will, however, be returned to competitors on arrival.

DURING January, members of the Strathtay Aero Club logged just over 135 hours' flying; they showed commendable keenness by completing over half this total in Tiger Moths, despite the rigours of open cockpits, in the wintry Scottish weather. Bad visibility severely curtailed cross-country flying in the club's Proctors. Social activity at Perth, the Strathtay Club's base, has been enhanced by a series of film shows and a party given by the Saudi-Arabian Course, whose members are under instruction.

THE Wiltshire Flying Club began its new year well by logging over 190 hours flying during January. Last year the club fell short of its 2,000-hour target by only three hours; its grand total since April, 1946, is now approaching 11,000 hours. Aircraft-maintenance work since last October has been intensive—on an average, five C. of A. overhauls a month have been completed—and the club's new engine workshop is expected to be in full operation next month.

Thruxton is expected to be the base of more than one entrant in this year's National Air Races. A probable starter is Mr. G. Marler, whose Miles Falcon was bought especially for the King's Cup Race.

NEWS of private flying in the Far East comes in the progress report of the Royal Singapore Flying Club, which flew 1,900 hours during 1950—a 200-hour increase on the corresponding figure for 1949. But for riots (and the subsequent curfew) in Malaya last year, the total would have been higher. During the recent Singapore Air Day, members of the club gave over 600 pleasure-flights to the public in a day, using Tiger Moths. The club fleet was recently increased by the acquisition of five Austers.

GLIDING NEWS

AS reported in *Flight* last week the Royal Aero Club is considering the inclusion of a display of glider aerobatics at the Festival of Britain National Air Races on June 23rd at Hatfield. At least two gliders are wanted, retrieving-vehicles will be provided, and approximately £50 will be available for expenses. Although such aerobatics are a popular feature of many air meetings, many gliding enthusiasts feel that they can hardly be said to demonstrate the function of a glider or sailplane, and that they do not contribute anything to the standard of soaring as such. In some quarters it is felt that the £50 offered as "expenses" would be of greater benefit to soaring if it could be offered as a Festival Year prize to any person raising a British National Record to a standard more closely approximating to that reached by other nations who are holders of international records.

ON behalf of member formations, the R.A.F. Gliding and Soaring Association has recently purchased four Slingsby T.31 two-seaters, two in kit form. The Association is still making good progress throughout the service, and 1951 should see the fruits of the great deal of ground-work which has been carried out during 1950.

MINIMUM qualifications for the post of chief test pilot to a B.G.A. flight-test group have been published. They include a minimum of 200 hours, of which at least 50 must have been on gliders of less than 1,250 lbs a.u.w. Not more than one-fifth of the applicant's power flying may count towards the total of 200. At least eight types of gliders must have been flown, and the applicant must have had experience of bungey, winch, aero-tow and auto-tow launching. Some cloud-flying experience is also required. Applicants will have to perform one specific test on a standard glider, and will submit a report on this test to the technical committee, who will also consider the applicant's knowledge by evidence, written examination or interview.

ARMSTRONG SIDDELEY GAS TURBINE DEVELOPMENT

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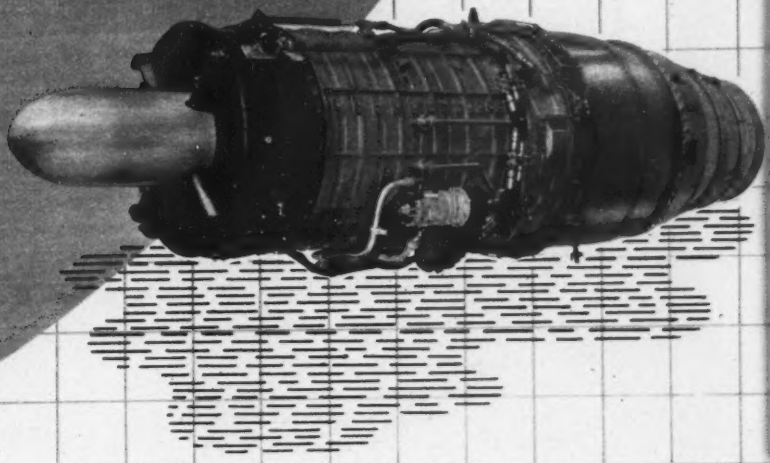

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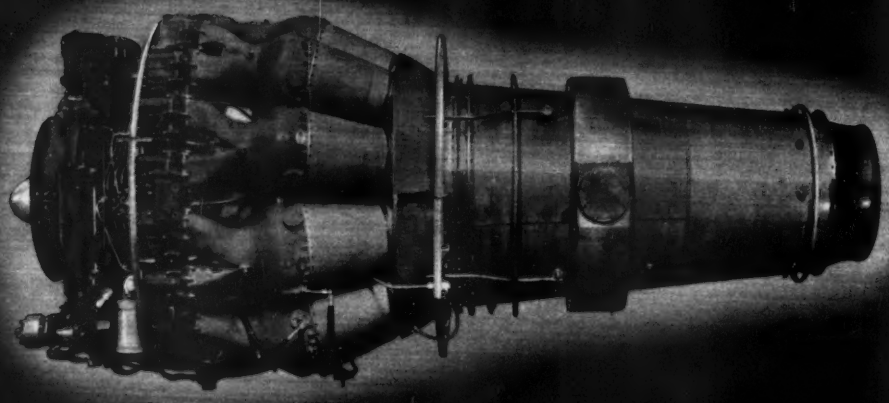


Chosen for large-scale production

for the Royal Air Force

DE HAVILLAND

THE DE HAVILLAND ENGINE COMPANY LIMITED, EDGWARE, MIDDLESEX, ENGLAND

Pleasing appearance and adequate performance are the predominant features of Auster's new floatplane conversion of which a photograph appeared in "Flight" last week. Once the necessary minor structural modifications have been made the machine can be quickly adapted for use on water or land in accordance with the operator's requirements.
("Flight" photograph)

AQUATIC AUSTER

Trials of a Simple Floatplane Conversion for the J.5, Aiglet and Autocar

THOUGH the light, single-engined floatplane is a familiar enough sight on the rivers and lakes of the United States and Canada, in this country the type is singularly uncommon. In latter years the few floatplanes which have been seen here have mostly been experimental conversions or adaptations of standard aircraft to carry out some special duty, usually in a remote part of the world.

Last year two Mk 6 Austers, fitted with floats, gave good account of themselves under especially trying conditions when they took part in the British-Scandinavian expedition to Queen Maud Land in the Antarctic. Benefiting by the valuable experience gained on these flights, Auster Aircraft, Ltd., have now entered the marine-aircraft field with a marketable floatplane conversion kit, suitable for the J.5, the Aiglet and the Autocar. In countries whose topography calls for light-aircraft versatility of this nature, a keen interest is likely to be displayed in this new venture.

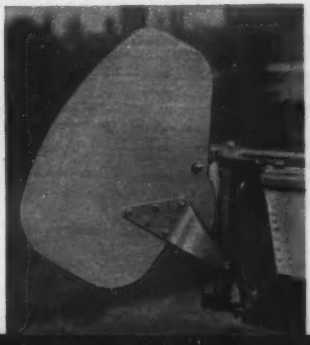
A recent visit to Beaumaris, Anglesey, where a J.5 (130 h.p. Gipsy Major) so modified was completing handling and performance trials—under the supervision of Mr. Geoffrey Tyson—to obtain A.R.B. approval, gave us an opportunity to inspect this enterprising conversion. The pontoons are of Auster design and construction, though based on the lines of the well-known Edo float. Fitting them entails some minor structural changes for the purpose of strengthening the existing fuselage, and a few new attachment points have to be added to take the stabilizer fin and the control wires to the water rudders located at the rear of the floats. The essential items for this work are supplied in the modification kit, and no special assembly equipment is needed, since the fittings can nearly all be bolted to existing parts.

On the J.5 it is also necessary to fit a fin and rudder of somewhat larger area; this, in fact, constitutes the biggest item in the whole conversion. On other types, notably the four-seater Autocar, the larger fin and rudder are already incorporated on the landplane version.

As can be seen from the accompanying photographs, the floats are large and sturdy; they are also of high hydrodynamic efficiency. Two mooring cleats are fitted on the forward ends. The only change in the cockpit consists of a pull-up cable—fitted below the throttle quadrant—for lowering the water-rudders. These are, of course, retracted for take-off and landing and, to avoid damage, before the floatplane is hauled on to the slipway. Once the initial strengthening details have been completed the Auster is quickly convertible from floatplane to landplane or *vice versa*.

Its flying characteristics are especially viceless. Though, of course, it would be folly to attempt to operate such a light craft in really rough water, the Auster floatplane can take a surprising amount of punishment. On opening the throttle the machine can almost immediately be eased on to the step and, although subsequent acceleration seems rather slow by landplane standards, take-off with a full load is normally accomplished in about 45 seconds. With little wind, distance to clear 50 ft is in the region of 800 yd. Once off the water the aircraft handles with the ease and lightness characteristic of all other members of the Auster

The control handle for the Auster floatplane's water-rudders. It is shown in the "up" position.



Spring-loaded retractable water-rudders are operated by a pull-up cable device in the cockpit.
("Flight" photographs)

AQUATIC AUSTER . . .

family. The only noticeable difference is that rate of climb and maximum cruising (90 m.p.h.) are a little slower than in the landplane versions. Stalls, whether with power on or off, are all quite straightforward and free from any tendency to be followed by a spin.

For landing on relatively smooth water, and on which there is no heavy swell, a glide approach can be used. If the aircraft is allowed to touch gently on the step, and the stick brought back as speed drops, there is no inclination to nose forward and a smooth landing will result. In rougher water it is preferable to make a precautionary approach, using engine, and to lower the aircraft on to the water in a more nose-up attitude; deceleration is then more rapid and the floatplane is less likely to bounce off the oncoming wave- or swell-crests.

With water-rudders lowered taxying is simple and the aircraft quickly responds to a touch of throttle. Rudder also is sensitive and manœuvring close in-shore is quite safe.

A long-range tank which can be fitted to the underside of the fuselage is not subject to water-buffeting, as the float bow-waves move back quickly and in any case tend to be fairly flat.

Altogether, the conversion has produced a floatplane of obviously rugged yet quite attractive appearance. The trials at Beaumaris have shown it to have a satisfactory performance, although there is little doubt that an extra 20 to 30 h.p. would give just that little extra zip which seems to be needed during take-off and climb.

Performance data are still subject to confirmation, but provisional figures at a take-off weight of 2,300 lb (equivalent to carrying three people) are as follows:—

10 m.p.h. Wind	
Take-off time	47 sec
Take-off distance	430 yd
Still Air	
Initial rate of climb	600 ft/min
Service ceiling	9,000ft
Cruising speed (2,050 r.p.m.)	90 m.p.h. T.A.S.
Max. speed	104 m.p.h. T.A.S.
Stalling speed (flaps down)	52 m.p.h. I.A.S.
Landing run	150 yd
Range	285 miles

The Human Factor

A Plea for a More Understanding Approach to Commercial-aviation Crewing Problems . . . .

By Capt. R. C. O. LOVELOCK

THE particular type of misrule which seeks to discount humanity altogether is known as bureaucracy. Its characteristics are unimaginativeness, the wet blanket, moral cowardice, and an obstinate belief that all events are of equal importance and will occur in alphabetical order. It fears criticism like the whip, and retreats before it in a solid phalanx, cowering nameless within cohorts of clerical mediocrity; it has a mariner's concern for its seams and its yardarm. Initiative, enthusiasm and exuberance shrivel alike in contact with this deadly, sterile curse which is the absolute antithesis of true leadership and of the English Elizabethan spirit. Only occasionally does Nature, to redress the balance, take her terrible revenge; then those who have had the presumption to ignore the human factor in their contrivances are themselves swept up and consumed in bitter personal experience of man's inherent frailty. With the best will in the world, lesser forms of incongruity (the result of genuine administrative expediency) will even creep into private enterprise, so in charter airlines there is no better and more constitutional safeguard against this than an active aircrew association. What does this liaison seek to prevent? What are the ethics of civil flying, and what ideals should guide both managership and captaincy in relations with crews?

In the writer's opinion, the problems are as follows. There are perhaps only two activities in the world in which it is justifiable to expect man to submerge his individualism within a discipline that transcends the ordinary requirements of law and order. They are, first, war, and secondly, long-range movement through the hostile elements of sea, desert or air. The activity of war, being the more dangerous, is governed by the stricter rule, hence military law embraces within its jurisdiction many factors which do not seem at first sight to bear upon the existence of the enemy at all. Discipline for the second activity is largely voluntary; it is the cohesion of sensible people, influenced by the "point of no return" in order to lessen the risks. Underlying all is the common-sense morality which guides people in their ordinary relationships, and makes them willing for a good day's work. Seafaring and desert travel have centuries of established practice behind them from which are evolved the laws and customs of the sea, and what T. E. Lawrence has called the "biting social discipline" of the nomad tribesman. Travel in these elements is undertaken with a habit of ceaseless vigilance and absolute obedience. Flying, in contrast, is not similarly a Way of Life. The speed of air travel, and the fatigue resulting from its intensity, ensure that its purposes are served within very short periods; moreover, since air forces were instituted before airlines, there is even to-day no invariable *modus operandi* based upon a simple flying tradition. Consequently, an illogical distaste, with no suggested alternatives, is felt by civil crews towards Service methods.

A tremendous difference in outlook must occur between the R.A.F. captain, who must sometimes force an aircraft and crew into danger, and a civil captain, who is expressly forbidden to do so. Up to this point the operating requirements are generally identical; it is just that the civil captain holds no mandate from war to strengthen his arm in handling the inherently delicate balance of relationships involved. With the exception of the navigator, who is combined with the co-pilot, each crew-member represents a specialist technical branch in which a captain ordinarily lacks parallel knowledge. Therefore, although his authority must still be absolute on account of possible emergencies, he is wise when making ordinary decisions merely to co-ordinate the opinions of his engineer and radio officers and should hesitate to overrule them. He must lead by spiritual rather than by tangible means, and his influence should be strengthened by every means in his employer's power. Not only should he be backed up strongly against outside interference when on the company's service, and his recommendations or complaints be carefully attended to, but every encouragement should be given in matters affecting crew cohesion. This quality is particularly important in charter work, since the essence of such work is to preserve the integrity of the enterprise when isolated from base. With no ubiquitous establishment of ground support, there is a tendency for the form of the technical relationship to perpetuate itself on the ground, where it is neither appropriate nor adequate; when delays or setbacks occur, it is necessary for the specialist function of each crew member to submerge itself in the conception of a loyal staff. Surely the first necessity is to "crew-up"? How would a business ever function if its personnel were exchanged for those of another company before every fresh task? A civil-aircraft captain commands fewer men than does a lance corporal, but he and his crew are responsible for an enormous basket of eggs. The writer believes that crews should be made up as far as possible on a voluntary basis, with facilities for "swapping" with other crews. It is true that in Bomber Command the authorities were motivated by a much

grimmer realization of the need for "crewing-up," that men are particular about the company in which they may have to die; nevertheless, the capacity of a good team to be better than the sum of its parts is too powerful a human impulse to be neglected. Representatives of the type who are motivated entirely by considerations of personal gain, and who think loyalty a weakness, should be "crewed up" together, to form self-curing "leper colonies," as in the American Air Force film *Twelve o'clock High*.

The question of the first officer is particularly worthy of attention. However tragic the present prospects of promotion, he should always be treated, and encouraged to behave, as a potential captain, because his eventual promotion is complicated by the fact that it will be "within the unit"—inside a small organization where everyone has known him as a junior. The pairing of captain and first officer should be the most carefully considered task of all, and should be voluntarily agreed to by both men. It must be a point of honour for the captain to provide opportunities for his first officer to be exercised in all aspects of his profession; in return, a captain can reap the inestimable advantage of having a loyal friend with whom to share the "loneliness of leadership"—a relationship which, in other professions and other ages, is as master to mate, knight to squire, or commander to first lieutenant. It might seem ungallant for a man to express an opinion whether air hostesses should be "crewed-up" or not. Certainly charter work is no background for romance, but a captain who has seen what heights of loyalty and devotion can be reached by women in acceptance of their responsibilities towards passengers would never deny that they can work well in a team.

Will there ever be an official method of assessing fatigue from flying which is as certain as this gift in a wife or mother? As the law stands at present the extra medical examination for those who have flown 120 hours during the period of thirty days does nothing more than to prevent an employer sending a man into the air when the flame of life is actually extinct. The journey to town when the whole body is crying for relaxation and sleep, and the subsequent pantomime at Theobalds Road, do not constitute a rejuvenation of the nervous system. Is there no means of repeating, in civil aviation, the patriarchal combination of squadron commander and medical officer who lived for their men, watching for the weakening of morale through strain, and thus being able to prevent behaviour of which a normally brave man might be ashamed? Fatigue is only a lesser stage of the same problem; that knowledge developed during the war could now be used to recognize those who are dangerously tired, and incidentally distinguish them from those who, tired or not, are pathologically unstressed for flying at all.

We belong to a trader nation which, to quote Lawrence again, has "thrown a girdle of humour and strong dealing round the world." Those things cannot be done by issuing fatuously ambiguous orders or administering patched-up justice. We are the successors of those who manned the old trading stations; perhaps a little more centralization than they experienced is necessary in our complicated lives; but, flying our great units of men and machinery over seas and deserts as well as through the air, we develop wide philosophical horizons, whether articulate about them or not. Real wisdom encouraged the formation of aircrew associations in private airlines. They might do much to ensure that the contracts which our contemporary pioneers have so hardly won can be safely and securely held.

LONG-RANGE NAVIGATION AIDS

Requirements for Inter-continental and Trans-oceanic Routes: Contemporary Systems Reviewed . . .

By PETER SINCLAIR

IN "Flight" of January 11th there appeared an article in which two competitive navaid systems approved by I.C.A.O. were compared. In response to suggestions that further "background" to this subject should be given—it appears that there is a demand for a somewhat less technical explanation of the various systems at present in use—we publish the present review. In it, the author sets out the pros and cons of current equipment.

As most readers of *Flight* are aware, there is considerable uncertainty about the ultimate international form of navigational aids. In the short- and medium-range field the existing chaos will be simplified in the immediate future by a certain amount of overlapping and the regional adoption of a multiplicity of navaids. In the case of long-range inter-continental and trans-oceanic aircraft, however, the difficulties are less easy to resolve. There is not a multiplicity of suitable aids available and, in any case, the problems of providing them on a world-wide basis are great, any solution depending as it must on world-wide co-operation. The aids must be equally satisfactory for tropical and arctic flying both by day and night, throughout the year.

The problems confronting the long-range flyer and the information he requires can be summed up as follows:—

(1) The position of the aircraft.
(2) The direction to fly to the destination or trunk-route turning-point.
(3) Height.
(4) Warning of the whereabouts of navigational obstacles more or less peculiar to long-range operation, e.g., mountain peaks and turbulent cloud formations.

In the past there has not been a great demand for precise long-range navigation. Schedules were not very stringent, E.T.A.s were rather loose and the risk of collision remote. Such conditions, however, are quite rapidly changing. Schedules and E.T.A.s will have to be considerably tightened, for two reasons. First, since trans-oceanic aircraft are flying faster and with heavier loads, the greatest care has to be taken to limit the amount of "deadweight" fuel reserve carried—a point which is greatly aggravated by the introduction of jet airliners where fuel economy is an absolute necessity, not just a requirement. Secondly, the integration of aircraft from long trunk routes into the existing traffic pattern in and around control areas must be achieved, and this can only be done effectively by E.T.A.s maintained as closely as those of the short-haul operators.

What, then, are the requirements of a long-range navigational aid? In general, they can be summarized as follows:—

(1) It must be possible at all times for the aircraft to obtain its position, either in relation to the ground or as distance and bearing to the destination.
(2) The aid must be capable of operation in all parts of the world.
(3) It should be suitable for integration into medium/short-range aids and landing systems.
(4) It should be capable of development as a means of providing automatic flight.
(5) A worthwhile I.C.A.O. requirement is that it should provide an indication of malfunctioning to the air user.

Not only must the system meet the above requirements, but it must do so with a certain accuracy minimum which should be at least as high as that obtained by astro-navigation under average conditions. It was agreed by the COT division of I.C.A.O. at Montreal that long-range navigational aids should provide coverage up to a distance of 1,500 nautical miles over the sea or 750 miles over land. It was further agreed that accuracy of fixing should be within 10 miles at 1,000 miles and above, 1 per cent of range between 500 and 1,000 miles, and 5 miles for ranges of 500 miles or less. Such accuracies are essential as, in the event of emergency, the more exact the fix obtained the quicker can an effective means of rescue be put into operation. The difference in the circular area of search resulting from errors of 10 to 30 miles necessitates a search of an extra 630 square miles. Also, reliable fixes are required to obtain

LONG-RANGE NAVIGATION AIDS . . .

accurate ground speeds and to determine wind speeds and direction, a necessity in long-range flying.

There is, unfortunately, a fundamental difficulty confronting the designer of long-range navigational aids which cannot at present be solved. In order to obtain long-range coverage it is necessary to use very low frequency waves, which will follow the curvature of the earth instead of shooting off in a straight line as in the case of V.H.F. transmissions. Although the choice of the low frequencies helps in this way, it has certain drawbacks; for example, and especially at night, the signals are received by more than one path, a direct one and others after reflection from ionized layers which surround the earth many miles above its surface. In the majority of navaids this effect can be most disturbing and leads to inaccuracies which are difficult to overcome. In general, the pulse systems score, as it is sometimes possible to check or calculate the number of "hops" present. In the case of Loran this method has been used to advantage and the charts are constructed with alternative position-lines assuming a different number of "hops."

In a continuous-wave system the time or distance measurements are usually made automatically by the radio equipment, and it is more difficult for it to sort out the true from the false answers. The equipment has been given a "brain" but, unfortunately, not one intelligent enough to solve this problem. Therefore, when sky-waves are being reflected, the point at which they first hit the earth and become stronger than the ground-wave is the effective limit of accurate cover. This may be at as short a range as 300-400 miles.

There are further fundamental problems in that coverage differs considerably over land and sea. Fortunately it is better over the sea—where there is the greatest need for navaids—being almost double the land range. This aspect presents great difficulty, however, to those trying to plan such cover over large, sparsely populated land masses.

As these long-range aids provide cover mainly for trunk-route operation the precise position of the station is not important. This is most fortunate, as they require very large aerial systems. Care has to be taken to consider such factors as subsoil condition and the nearness to coastlines, as it is possible for "bending" to take place where these long waves cross from land to sea paths.

The airborne equipment also requires a long aerial for effective reception. In the past this aerial has usually consisted of a trailing wire or an aerial strung between, say, the wing or nose and the tail of the aircraft. With the advent of fast jet aircraft the problem of providing a suitable aerial is greatly aggravated; "suppressed" aerials must be used, consisting of strips of metal, or in some cases of portions of the fuselage or wing, insulated from the remainder of the aircraft.

In spite of such problems as the foregoing, there are several aids in use at the present time, and the following is a summary of those available.

Loran is a pulse hyperbolic system utilizing pairs of stations situated many hundreds of miles apart, each pair laying down a pattern of hyperbolic curves. By means of a receiver, with timing circuits and a cathode-ray tube, it is possible to establish the position of the aircraft on one of these curves. Readings taken on two pairs of stations will give the position on two intersecting lines, thus constituting a fix. Standard Loran operates on a frequency of approximately 2.0 mc/s and therefore the range is extremely good —by day, over the sea, it is 600 miles, and at night it is increased by reflected sky-waves to 1,200 miles.

Low-frequency Loran is still under development and, although little information has been released, it appears that ranges of 1,000-1,800 miles can be expected with an accuracy of the order of four to five miles. One of the disadvantages of this system is undoubtedly the large ground aerials required—approximately 1,000 feet in length.

The Decca Navigator is a somewhat similar hyperbolic system, but in this case time measurements are by C.W. phase comparison. Theoretically, due to the low frequencies used, very long ranges can be expected, but in practice it can become inaccurate when sky- and ground-waves mix. This occurs at night at ranges of about 300 miles.

Low Frequency Omni-range lays down a pattern of radial bearing lines emanating from the station but, again, this system will suffer from the propagation troubles of sky- and ground-wave interference which affect all C.W. systems on low frequencies.

Consol is a rotating-beacon system which provides a bearing from a point. Its great advantage is that no special airborne apparatus is required; it is only necessary to use the normal communication receiver. Operation is by counting a number of dots and dashes transmitted in fairly rapid succession, though in view of the high static-noise level encountered on these frequencies the process can be most tiring. The accuracy of the readings is not good in the two sectors of about 50-60 deg which lie on each extension of the base line. In the remaining sectors, however, it is quite high.

Apart from those aids, which are ground-transmitted, there are two further important types of airborne equipment which have to be considered. First there is an accurate radio altimeter which can be extremely valuable for pressure-pattern navigation and for use in tropical monsoon areas, when, due to the presence of turbulent clouds rising perhaps to 25,000 feet, it may be necessary to fly underneath them at almost sea level. Secondly, there is airborne search radar, either of the H2S pattern or in a later development, cloud-and-collision-warning radar, which can be used to obtain navigational information from towns, rivers or other landmarks over which the aircraft is flying.

What does the future hold in store for the long-range navigator? What trend will the design follow?

There will most certainly be a continuation of the conflict between the systems which lay down a fixing pattern by means of hyperbolæ and those which provide a radial pattern from a point source.

The choice between pulses and C.W. will be a difficult one. Pulses are less prone to propagation troubles, but continuous waves are looked upon with great favour because they take up less space in the crowded radio spectrum.

The fixing-pattern systems in general require more than one site which may be a problem when the size of them is considered. The single siting of the angular system is very much in their favour.

Whatever system is finally adopted, it is certain that those which provide information suitable for feeding into an automatic pilot to provide automatic navigation will stand the greatest chance of world-wide adoption, as many airlines are eager to cut down the number of crew members carried.

It may well be that, under the blanket of security which is now enshrouding research, a more revolutionary type of aid is being considered. Let us hope that this is so, for its birth is eagerly awaited by the world of aviation.

BELFAST APPRENTICES REWARDED

AT the third annual apprentices' prize day, held recently at Short Brothers and Harland, Ltd., over 100 apprentices received recognition. The prizes were presented by Lady Rebbeck.

Outstanding among the senior awards was that to L. Hawe who, in addition to being the winner of the Capt. J. S. Davidson Memorial Exhibition, 1950, received the company's Apprentices' Association Prize as the best all-round third-year apprentice.

J. H. McClean, now on a two-year course at the College of Aeronautics, for which he was awarded the Short Brothers and Harland Directors' Bursary, was the winner of the Capt. J. S. Davidson Memorial Exhibition, 1947, and was also the first apprentice to bring the Hele-Shaw Memorial Prize to Northern Ireland, in 1949.

A. Daffey, R. L. Makemson and R. Frost were awarded prizes in recognition of their successful completion of the Final Part II B.Sc. Engineering. Frost's degree carried 2nd Class Honours.

The chairman, Mr. E. D. A. Herbert (upon whom a Knighthood was conferred in the New Year Honours), said in his address that a decisive factor in influencing the company's transfer to Northern Ireland was the supply of suitable young men to enter into aeronautical apprenticeships; the expectations of the directors in this respect had been fully realized.

Like all examples of good engineering, the Bristol Fighter looks "right." It is seen here taking off from Filton in the hands of "Bill" Pegg.

A "BRISFIT" FLIES AGAIN

ON February 14th, nearly 35 years after the prototype Bristol F-2B Fighter made its first flight, an exactly similar aircraft was successfully test-flown at Filton by the Bristol Aeroplane Company's chief test pilot, "Bill" Pegg of Brabazon fame.

The aircraft had been rebuilt by the company for the Warden Aviation Co., who maintain the Shuttleworth Collection of historic aircraft and fly them at displays. It had been brought to Filton by road at the end of last year and examination showed that, despite long years of storage, airframe and engine were in amazingly good condition. Only minor replacements were needed, and Rolls-Royce, to whom the Falcon engine was sent for overhaul, found a bench test unnecessary.

Although it was about 20 years since "Brisfits" had been seen in the shops, Mr. K. Hayward (assistant general manager, aircraft division) soon got together a team of men who, like himself, had worked on F-2B production lines in 1917. Rigging was supervised by Gilbert Williams, flying-school foreman, who not only helped to build Bristol Fighters but had many years' experience of rigging them for Mr. C. F. Uwins when he was chief test pilot.

The pilot discusses the Fighter's performance with Bristol personnel. They are, left to right, Messrs. A. H. Neads and L. F. Mayer (engine installation department) and Gilbert Williams, who was largely responsible for successfully rigging the aircraft.

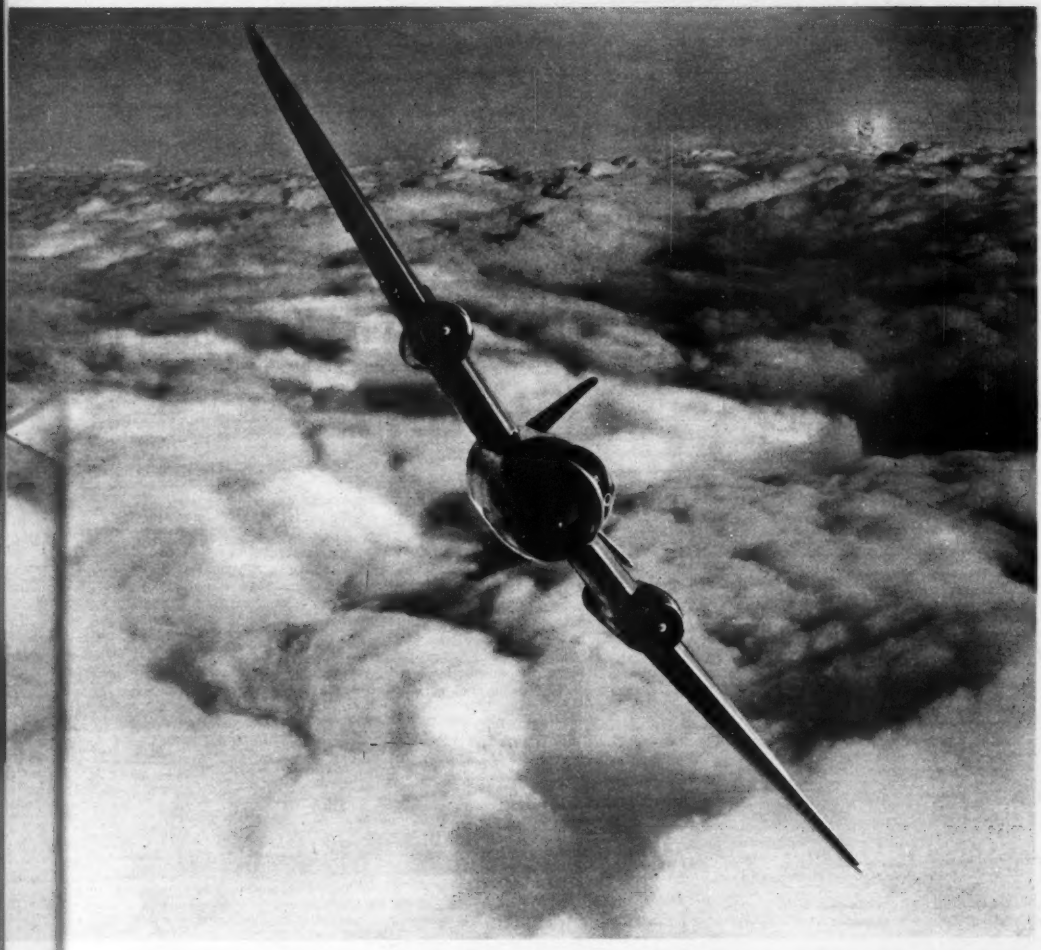
Taxying tests were made on February 13th. The aircraft was wheeled on to the grass of the airfield and Mr. Pegg, who had flown the type in the R.A.F., checked the controls. Three men linked hands to swing the airscrew, and after two swings the Falcon woke happily to its new life.

Bumping and swaying over the grass and sending up showers of sparks from its tail-skid as it crossed the concrete runways, the biplane taxied into thick mist and disappeared from view. When he returned, Mr. Pegg said that he had lifted the aircraft off the ground, but, because of a tricky cross-wind which was blowing, had decided to put it down again immediately.

On the following day, Mr. Pegg made two take-offs and landings and, during one flight, beat up the small crowd of spectators. "The rigging was perfect," he said on landing—a tribute to the enthusiasm, skill and long memories of the Filton old-timers.

POWERFUL BASIC TRAINER: P.56 WITH ALVIS LEONIDES

Recently selected to follow the Prentice as the standard R.A.F. basic trainer, the Percival P.56 is seen for the first time with a trimly cowled Alvis Leonides engine (500 h.p.)—to be the standard power-plant for production versions. Other P.56 photographs—the first in the air—are on page 265.



UP AND DOING

Action Studies of the English Electric Canberra

WEEK by week the renown of the English Electric Canberra spreads over the world. Though as yet only a handful of these remarkable jet bombers exists, very large production is in hand. The direct west-east crossing of the Atlantic from Aldergrove, Northern Ireland, to Gander, Newfoundland (see report, and eye-witness account of take-off on pages 246-247) will further the chances of the success of the Canberra not only in Great Britain and Australia (known officially to have adopted the type) but in America also, where the possible use of the Canberra in the night intruder role is foreseen. A caption to Canberra photographs in the February 15th issue, incidentally, should have read that the aircraft would demonstrate in America "the qualities which have led the U.S. government to consider [not "order"] quantity production in their own country."

In no aspect of performance is the Canberra more remarkable than in manœuvrability, some measure of which is conveyed by the studies on these pages. The *Flight* photograph of the machine on the climb is especially characteristic, for ever since W/C. Roland Beamont (who made the initial flight on May 13th, 1949) lifted the first Canberra from the runway at Farnborough at the S.B.A.C. Display in 1949, a steep initial climb has been closely identified with the type.

"Flight" photograph

FLIGHT RESEARCH

Mr. Handel Davies's R.Ae.S. Lecture
Part II : Stability and Other Aspects

In last week's issue we summarized the first part of the lecture, "Some Aspects of Flight Research," given before the R.Ae.S. on February 15th by Mr. Handel Davies, M.Sc., F.R.Ae.S., A.F.I.Ae.S. He dealt with drag analysis and the achievement of laminar flow; in the second part (a digest of which follows) he goes on to discuss stability investigation, some general aspects of flight research, and the requirements of a test pilot.

IT was obvious, said Mr. Davies, that flight research and development on aircraft must play an extremely important part in achieving good stability and control characteristics. Not only were the pilots' impressions of the handling characteristics the final criterion by which an aircraft must be judged, but there were still many basic stability and control characteristics which could be investigated adequately in an actual test-flight.

The problem of achieving satisfactory longitudinal stability throughout the speed range, had been complicated greatly by compressibility effects at high speed, and by difficulties arising from the use of unorthodox plan forms at low speeds. The use of sweep-back to delay and reduce the compressibility effect made it more difficult to retain adequate longitudinal stability down to the stall. A typical example of the sort of variation in static stability which could be expected of a modern high-speed aircraft showed instability occurring at the lower speeds, changes of trim occurring at transonic speeds involving regions of large negative static margin, and a virtually inevitable increase in static stability at supersonic speeds.

These effects depended on a large number of factors, the systematic investigation of which was possible only by wind-tunnel tests and other model techniques. The objectives of flight research in this field were (i) to provide constant checks on the model techniques; (ii) to investigate special effects which were not present, or were difficult to represent fully, in model tests; (iii) to assess, from the pilot's point of view, the importance of the changes which occurred, so that the minimum standards to be aimed at in design could be established.

On the whole, fairly good agreement was shown when the wind-tunnel Reynolds numbers were high enough, and provided that no appreciable aeroelastic or other effects not represented in the tunnel occurred. These additional effects were often important, however; for example, severe nose-down trim-change on a Vampire was eliminated by comparatively minor modifications to the elevator shroud.

A great deal of work had been done on the third objective listed, and certain standards had been laid down. Unfortunately, the rapid increase in performance over the past few years, and the trend toward unorthodox plan forms had made many of the requirements incomplete, and in some cases, out of date. On all high-speed aircraft, as the Mach number was increased, a stage was eventually reached when a more or less severe nose-down trim-change occurred. This inevitably meant a large reduction of static margin in this region, and in most cases, the static margin would become substantially negative. Fortunately, this was not accompanied by a corresponding loss of manœuvre margin; on the contrary, the stick force per g generally increased rapidly in this region.

The lecturer thought that large negative static margins might be accepted at high Mach numbers, at any rate for relatively short periods, provided they were accompanied by positive manœuvre margins. At high speeds, the important static longitudinal stability requirements seemed to be (i) that the manœuvre margin should remain positive and that the corresponding values of stick force per g should be within the limits previously accepted; (ii) that the trim-changes due to compressibility should be gradual; (iii) that the trim-change should be within the capacity of the pilot either by use of elevator alone or by a combination of elevator and variable incidence tailplane.

With the introduction of sweep-back and other unorthodox plan forms, satisfactory lateral and directional stability characteristics might not be easy to obtain. In the first place, the values of l_v and n_v for a particular design were likely to vary quite rapidly with C_L instead of remaining sensibly constant as for straight-wing aircraft. As a result, it had become more difficult to choose values of dihedral and fin area which would be satisfactory over the whole flight range. Sweep-back also resulted in a reduction of aileron effectiveness, at any rate for conventional aileron design. Finally, the small aspect ratios often associated with sweep-back, and the tendency toward tip-stalling on swept-back wings was liable to result in low damping in roll, particularly at low speeds. It was obvious that these effects were likely to lead to some difficulty in achieving ideal lateral and directional handling characteristics.

Evidence of low damping of "Dutch roll" oscillation had occurred on swept-wing aircraft in flight. These aircraft did not, in fact, satisfy the well-known requirements for the damping of lateral oscillations. British requirements specified that any lateral or directional oscillations should be damped to half amplitude in one complete cycle; American requirements were slightly less severe, but both demanded a fairly heavy damping. Experience on swept-wing tailless aircraft in Great Britain had shown that, although a divergent "Dutch roll" occurred at approach speeds, the amplitude doubling in about four cycles with a period of about 4.5 seconds, the pilots did not consider these characteristics to be unacceptable. It seemed that they were able to cope with oscillations of this fairly long period without difficulty. It was, however, probably more difficult for the pilot to cope with a badly damped "Dutch roll" on a very large aircraft even when the periods were correspondingly longer, owing to the slower response of such aircraft to corrective actions. It was probable that the lowest period with which a pilot could cope by using his controls was of the order of two or three seconds, although this limit depended to some extent on the size of the aircraft, and the precise nature of the oscillation. Periods of less than two seconds were not very likely at approach speeds, but they might occur frequently at high speeds, and a new factor then entered into the problem for military aircraft—namely, the standard of damping needed in order to give satisfactory fighting qualities. It was probable that under these circumstances damping to half amplitude in one cycle was not good enough.

It was not easy with the present design trends to achieve the desired standards. Automatic means of increasing the damping to meet this problem had been developed, and the lecturer referred to the early work of Dr. Doetsch at the Royal Aircraft Establishment in this connection. Extensive flight tests had been made in this country to improve these artificial damping devices; the method could also be used to prevent "Dutch roll" at low and moderate speeds. The fact that the dynamic stability characteristics of an aircraft could be improved artificially in this way should, however, not be allowed to encourage any relaxation in the efforts to achieve satisfactory characteristics by purely aerodynamic means.

Mr. Davies went on to observe that the development of controls and associated devices, such as air brakes, g-restrictors and so on, had always been an important objective of flight research. As an illustration, for the purpose of the lecture, of the contribution which flight research had made in this field, a special problem would be taken which had recently come back into prominence, namely, the development of spoilers for lateral control.

The possibility of using spoilers for this purpose, thus freeing the whole of the wing trailing-edge for landing flaps, was realized many years ago. Wind-tunnel tests indicated that adequate rolling effectiveness could be achieved, but early flight tests were not very promising. Design trends during the past few years, however, had introduced new factors favouring the use of spoiler control. In the early flight-tests of spoilers, the troubles in achieving satisfactory feel arose from two different factors depending on the type of spoiler. With a hinge-type, great difficulty was experienced in producing reasonable linear hinge-moment characteristics with deflection. None of the modifications tested gave really satisfactory results. Subsequent tests on an American aircraft, the Vought Kingfisher, fitted with a slot-lip-type spoiler, showed that with this design an approximately linear variation could be obtained. A slot was cut in the wing immediately behind the spoiler hinge, and a scoop linked to the spoiler in such a way as to admit a varying flow of air through the slot as the spoiler opened, thus enabling the

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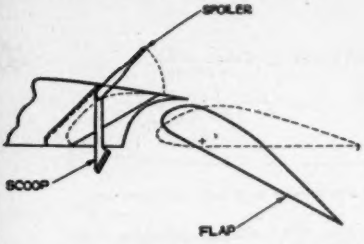


Fig. 7. Slot-lip aileron on Vought Kingfisher

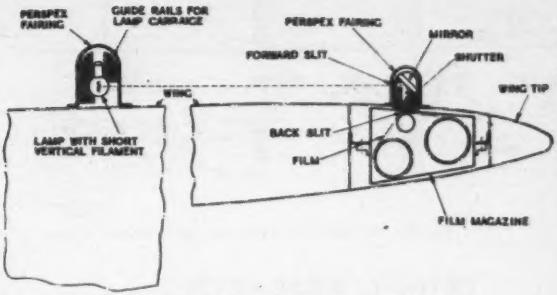


Fig. 8. Method of recording shock-wave contour on Vampire wing.

FLIGHT RESEARCH . . .

hinge-moment characteristics to be varied by altering the linkage between the scoop and the spoiler (Fig. 7).

Later experiments on a Falcon aircraft showed that the hinge-moment trouble could also be avoided by using circular-arc-type spoilers, providing that they were carefully designed with their hinge lines at the centre-line of the arcs. This type of spoiler was used with considerable success on the Black Widow night fighter, where the spoilers were combined with a small feel-aileron; there were, however, considerable inertia effects. A similar arrangement tested on a Halifax proved reasonably satisfactory from the feel point of view, but at speeds below 130 m.p.h. the rolling moment produced by the spoilers was greatly reduced, and there was appreciable lag.

The problem of achieving satisfactory feel with spoiler control was still a matter of some difficulty, although it was not insuperable. There was the possibility of using power control, a complication which was accepted for other control surfaces on most advanced aircraft.

The lecturer stated that, whilst flight tests on spoiler controls in the past had not been very encouraging, they did not rule out the possibility of designing spoilers which might be reasonably satisfactory. In view, therefore, of the greater arguments in favour of lateral controls of this type arising from the use of sweep-back and other design trends, there seemed to be a case for reconsidering the use of spoilers on modern designs, and, perhaps, for further flight research to investigate the points which remained doubtful.

The investigation of substantially fundamental aerodynamic problems in flight was not easy, but valuable work undoubtedly could be done in this field. It was also possible to use aircraft simply as an alternative means to a wind tunnel of providing the airflow in which to test models. In order fully to understand the nature of the compressibility effects which occurred on an aircraft, it was desirable to examine in detail the characteristics of the airflow. The usefulness, for example, of methods of photographing or visualizing the shock waves on an aerofoil had been recognized in wind-tunnel work, and many attempts had, therefore, been made to devise methods of photographing or visualizing shock waves in flight. Two interesting methods had been developed recently by Dr. Lamplough at the R.A.E.

The principle of the first, known as the "contour method," was illustrated diagrammatically in Fig. 8. A small light-source was arranged to move chordwise in a Perspex fairing mounted on the wing surface. The light poured through a chordwise slit in a fairing mounted as shown and was reflected by a mirror inside the fairing through another parallel slit on to a photographic film which moved in a spanwise direction. Thus any obstacle placed on the wing surface between the light and the fairing would produce a diagonal shadow on the film. Similarly, any discontinuity in pressure, such as occurred at a shock wave, would produce a trace on the film.

Fig. 9 showed a typical record obtained with this technique on a Vampire. The record suggested that the shock wave was of "corrugated" form, each of the wavy diagonal traces on the film coming from one of the corrugations. The slope of each of the diagonal lines indicated the spanwise position of the corresponding corrugation in the shock wave. The waves in the diagonal traces indicated that the whole shock wave was oscillating chordwise at a frequency of the order of 30 cycles per second, with very small amplitude.

The straight diagonal lines on the film indicated the existence of pressure discontinuities ahead of the main shock and fixed in position, i.e., not oscillating. These were found to correspond in position to rivets near a skin joint at the front spar.

It would be seen that this method was particularly applicable to the investigation of any phenomena involving shock-wave oscillation, or to the location of small shock waves caused by imperfections in the wing surface, as well as the main shock itself.

The method did not, however, enable the nature of the actual shock wave to be examined, nor reveal its inter-action with the boundary layer, and an attempt had been made to develop a method of obtaining "profile" photographs of the shock waves in flight.

In this method a parallel beam of light 2½in high by 5in wide, from an astrograph bulb and collimating lens, was projected along the plane of the shock wave and then condensed through a small aperture into a Robot camera without a lens (see Fig. 10). Fig. 11 showed a typical result obtained by this method. The photographs were complicated by the presence of shock waves arising from the lens installations, but it was possible to locate the spanwise position of the shock waves from the lateral shift of the shadows in a small band of light passing through a glass wedge near the collimating lens.

When the photograph shown in Fig. 11 was taken the boundary layer was turbulent at the shock wave, and its thickness could clearly be seen. Attempts had been made to improve the wing surface so as to get the transition back to the shock wave, but so far without success.

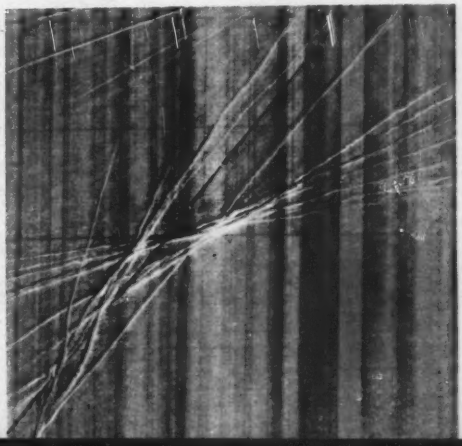
The potential usefulness of both these methods was obvious, not only for basic research on shock-wave characteristics under full-scale conditions, but also to locate and investigate the effects of local shock waves on particular aircraft.

The possibility of obtaining useful aerodynamic data by mounting models in the airflow round an aircraft in flight was obvious, and the method had, in fact, been used occasionally in the past. Small models were mounted above the wing surface of a high-speed aircraft in the region where the flow became supersonic when the aircraft itself was flying at high subsonic Mach numbers. The method had been employed in the U.S.A. and Canada, using Mustangs, and in this country with the Vampire. On both these types, it was found necessary to modify the wing section by means of a "glove" over a short length of the span in order to provide a region of reasonably uniform pressure-gradient at transonic speeds. In the case of the Vampire glove (Fig. 12), there was a variation of the order of 0·009 in Mach number per inch in the worst case; experience so far suggested that, in spite of this, reasonably reliable results could be obtained at any rate for wings of not more than about 4in semi-span, and fairly small aspect ratios. The models were mounted on a turntable flush with the surface of the glove, and the forces on it measured by means of a three-component strain-gauge balance mounted inside the wing.

It seemed that the results obtained by the so-called wing-flow technique gave a reasonable indication of the trends likely to occur at transonic speeds. The method, therefore, could be regarded as a useful, though temporary, means of supplementing transonic measurements by the free-flight model technique until transonic wind tunnels became available.

In reference to research aircraft, Mr. Handel Davies commented on the suggestion, sometimes made, that they did not

Fig. 9. Shock-wave contour record on Vampire wing at $M = 0.77$.



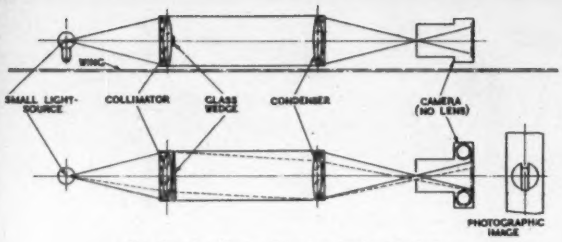


Fig. 10. Installation for photography of shock-wave profiles.

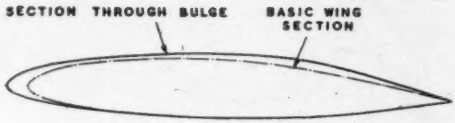


Fig. 12. Wing—flow-profile shape of bulge fitted to Vampire wing.

FLIGHT RESEARCH . . .

repay the undoubtedly great expense involved in designing and building them. He thought that nothing could be farther from the truth. The general background of actual flight experience provided by such aircraft was undoubtedly of incalculable value, not only in pointing the way to improvements in the design of Service aircraft, but also in drawing attention to problems which might need fuller investigation by other methods. Occasionally, the results obtained from a research aircraft were somewhat negative in the sense that they indicated the particular approach being investigated as being the wrong one. At other times, the results gave the designer confidence which no amount of wind-tunnel testing could have given to go ahead with the much greater risks and commitments involved in an advanced production design. In each case, the aircraft would have provided information and experience which could not have been obtained in any other way.

There were, however, three provisos. The rate of progress which had to be maintained in these days, both in research and in production, was so great that a research aircraft, if it was to pay its way, had to be built in a very short time. It was of little use planning a research aircraft if it was to be four or five years before it began to provide the necessary experience and data. By that time, the risks and gambles which the aircraft was designed to investigate would have had to be taken on a production design.

The second proviso was that, once the aircraft had been built, the research work for which it was intended should have the highest priority, and should proceed with the utmost energy and resource, often to the exclusion of many tests to which a normal Service prototype was subject. The third proviso was the obvious one that all the research aircraft to be built should be carefully planned in advance, so that the field could be covered as adequately as possible with the minimum number of designs. This was not easy, since it required a delicate balance between the needs of research as a whole and the needs of the individual firms concerned who had to build the aircraft. This proviso, however, was particularly important to Great Britain with its limited resources.

The lecturer concluded with a reference to what he assessed as "the most important link in the whole process of flight testing, namely, the pilot." The first requirement was that he should be an exceptionally good pilot on normal standards, quite apart from test flying, capable of accurate flying under all conditions, and above all, keen and enthusiastic about flying in general, and test flying in particular. He had to have the capacity for describing clearly and objectively all that happened in a test flight, keeping an open mind and avoiding, whenever possible, the temptation to interpret what happened in the light of his own technical background. That is to say, the pilot should always try to describe what happened rather than what he thought had caused it to happen. On the other hand, he had to be willing to try to understand the technical objectives of each experiment, even when it seemed mysterious and academic. Only a very broad technical background was needed for this purpose, the sort of background which was provided by the Empire Test Pilots' School in this country. The pilot should keep in constant touch with the technicians, taking an active interest in the results being obtained, as well as in the methods and techniques used in the tests themselves. He should try to maintain a critical outlook, not hesitating to make suggestions or criticisms when necessary.

Mr. Davies took the opportunity of paying a special tribute to all the pilots who had taken part in the work described in his lecture, and stated that a very large measure of the credit for the work had to go to them.

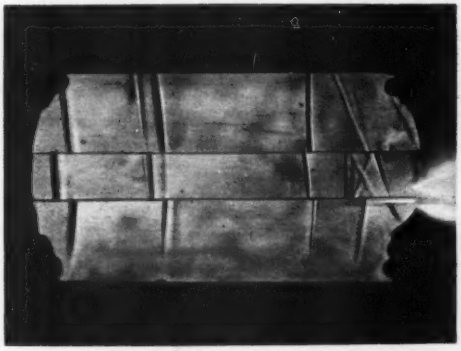


Fig. 11. Shock-wave profile record on Vampire wing at M = 0.77.

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Farmer and Stock-Breeder Year Book 1951, by Farmer and Stock-Breeder Publications, Ltd. Price 7s 6d.

Basic Refractories: Their Chemistry and Their Performance, by J. R. Rait. Price 60s.

The Motor Cycle Diary, 1951. Price (morocco leather) 5s 6d; (rexine) 3s 8d.

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Technical Instruction for Marine Radio Officers, by H. M. Dowsett. Price 60s.

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Radar Simply Explained, by R. W. Hallows. Chapman and Hall, 37, Essex Street, London, W.C.2. Price 10s 6d.

Atomic Energy for the Layman, by Sir Arthur L. Dixon. Chantry Publications, Ltd., 63, Neal Street, Shaftesbury Avenue, London, W.C.2. Price 8s 6d.

Power Duration Models, by R. H. Warring. Percival Marshall and Co., Ltd., 23, Great Queen Street, London, W.C.2. Price 6s.

Fly With the Pilot, by Alan Buck. Quality Press, Ltd., 18, Adam Street, Adelphi, London, W.C.2. Price 3s 6d.

The Navy Year Book and Diary, 1951. The Navy League, Grand Buildings, Trafalgar Square, London, W.C.2.

Planning in Practice, by Ely Devons. Cambridge University Press, Bentley House, 200, Euston Road, London, N.W.1. Price 10s 6d.

Aeromodeller Annual, 1950. The Model Aeronautical Press, Ltd., Allen House, Newarke Street, Leicester. Price 7s 6d.

Whites Air Directory and Who's Who in New Zealand Aviation. White's Aviation Publications, Dilworth Bldg., Auckland, C.1., New Zealand. Price 7s 6d.

Appointments in His Majesty's Colonial Service. His Majesty's Stationery Office, York House, Kingsway, London, W.C.2. Price 2s.

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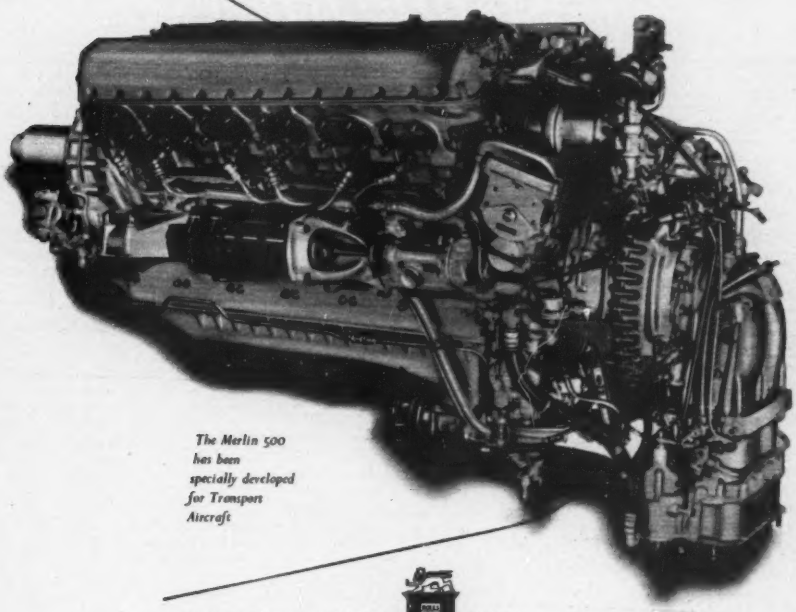

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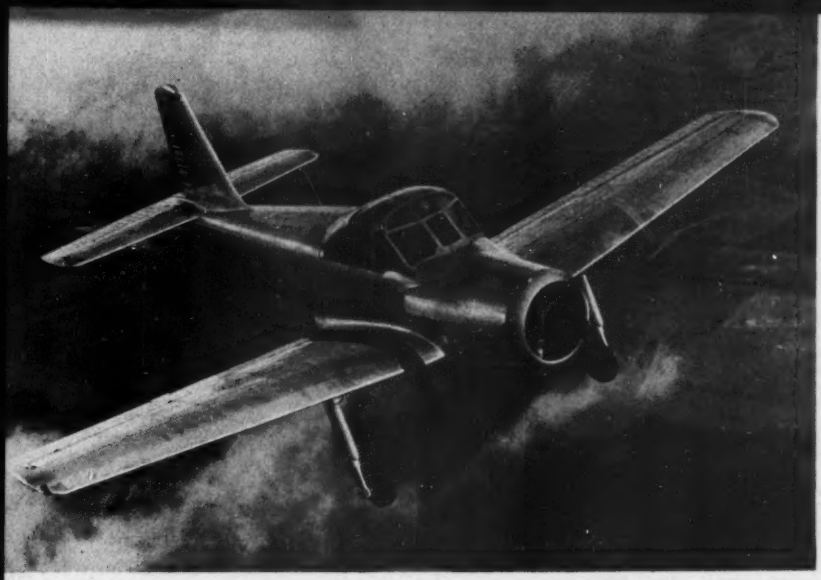

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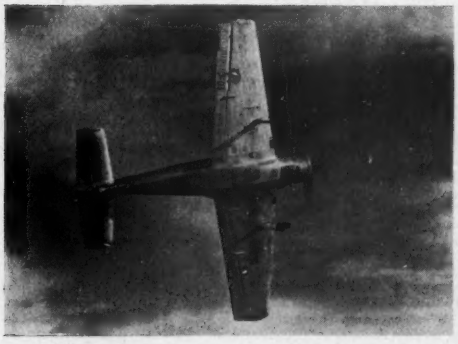

Impressions of docility and agility are combined in these first in-the-air "Flight" photographs of the Percival P.56—qualities which will be appreciated daily by R.A.F. instructors and pupils when the new basic trainer comes into service. The P.56 has been adopted as the successor to the Prentice, and replacement will begin late next year. Points to note are the aircraft's simple, robust layout and the remarkably neat cowling of the 500-hp Alvis Leonides engine.

The Leonides, driving a constant-speed airscrew, gives the fully-aerobatic P.56 a commendably high performance. Maximum speed is 174 knots at 5,000 ft, and the aircraft cruises at over 140 kt. The take-off run—quoted as 288 yd at full load to clear 50 ft from a grass field — is particularly impressive.

MAKING AIR TRANSPORT PAY

Mr. Masefield's Brancker Memorial Lecture. Part III: A New Approach to Economics

IN *Flight* of February 15th we gave abstracts from the early sections of the Ninth Brancker Memorial Lecture, read before the Institute of Transport on February 12th by Mr. Peter Masefield, M.A., F.R.Ae.S., M.Inst.T., chief executive of British European Airways. The part in question dealt with the historical background of British air transport, and in a second instalment, last week, we continued that section and then went on to summarize the lecturer's comparisons between operating costs in the early era and those of today. In a third series of abstracts, given below, an important new method of operational costing and assessment is explained.

Although [said Mr. Masefield] the past has been a period of development, consolidation and technical advance—both in the air and on the ground—it has been marred by the disruption of six years of war, by an unfortunate instability in organization and personnel brought about by economic necessity, and by a sad discontinuity of policy on the part of successive governments. The future undoubtedly holds promise: what is required is peace—and stability of administrative purpose. The lessons of the past are obvious.

One of the chief factors which has caused confusion in the past has been the lack of a clear-cut basis for cost analysis and, in particular, inability to distinguish the costs which are fundamental to the purpose of developing air transport as a serious commercial business. With these points in mind, and having examined in detail the costing methods which are commonly in use on both sides of the Atlantic, I have felt for some time that a new approach is needed. Accordingly, we in B.E.A. have recently been seeking such a new approach to costing and assessing the results in practice. It is, in fact, an attempt to establish a basic philosophy towards airline cost analysis and control.

An objective examination will reveal that the three major influences on airline profit and loss are:

(*a*) The particular type of aircraft.
(*b*) The standards and circumstances of the airline concerned.
(*c*) The route pattern being operated—especially the stage distances.

These three basic influences are, of course, critical to any cost analysis. They determine the problems and the profitability of any specific undertaking. Two of them are not taken into account in the comparative formulæ which are in use—the British S.B.A.C. formula and the American A.T.A. formula; and this means that such formulæ, although valuable for unquantitative comparison, are of little use in gaining practical figures of likely operating costs in any particular circumstances.

The costs related to the three major influences can be divided under two main heads:—

(1) *Overhead Structure of the Airline* (related to the general scale of effort but not directly to the number of hours flown).
(2) *Variable Operating Costs* (i.e., costs governed directly by the amount of flying done).

Such a breakdown approximates to the American conception of "direct costs" and "indirect costs." To be useful it needs further particularization and development. First, however, it is important to appreciate the purpose behind such an approach to airline costing.

To every scheduled airline operator the important period of costing comes before the event and not *ex post facto* after the damage has been done. Costing related to all the significant factors must be done as accurately as possible before a particular service is operated and assessed in relation to the type of aircraft concerned, the allocated overheads and the route characteristics. All this is essential to both planning and control.

It means, in fact, that the cost breakdown must be related and applied primarily to budgeting—and then checked against results. The maxim is: "Cost your operation before you fly" (to be sure that it is worth flying) then "Check the results against the budget" (to be sure that the worthwhile results are achieved). Such an approach is, I believe, the only way to bring air transport from a costly liability to a profitable enterprise.

In the first place, it is necessary to be clear about particulars needed on which to base a budget for an operating programme for, say, a year ahead. Every budget programme must begin with a detailed traffic estimate on the network of routes to be operated, taking into account the types of aircraft involved, the nature and extent of the competition, and the fare-structure applicable. The traffic estimates, route by route, provide an assessment of the revenue load ton-miles which can be set as a target to be achieved. The load capacity of the type of aircraft to be used and the desired commercial frequency of operation determine the load factor—ideally around 65 per cent—and from that the capacity ton-miles to be offered can be calculated directly.

The capacity ton-mileage and the frequency of service together determine, first of all, the flying hours required and secondly the scale of the overhead structure necessary to sustain the required effort. The flying hours required and the intensity of operation by individual aircraft determine the variable operating costs which, when added to the overheads, give the total cost of operating the network.

The revenue estimate comes from a direct application of the rates of carriage to the revenue load ton-miles sought. Again the whole pattern must be built up, route by route. A nice compromise between the promotion value of low rates and the revenue return of higher rates has to be accurately "guestimated" at an early stage—and for international services cleared both with other operators and governments through I.A.T.A.

In this conception, the economic results are essentially tied to the types of aircraft operated and to the stage distances of individual routes, as well as to the airline characteristics as a whole. Against the background of the predominant characteristics of the aircraft concerned, the main objectives of the cost analysis are as follows:—

(*a*) To isolate the major factors influencing the economy of operations so as to make possible rapid and accurate forecasting of costs and revenue for specific route patterns flown by particular types.
(*b*) To provide a means of checking—for control purposes—the more significant actual costs incurred against those forecast in a budget.
(*c*) To offer a standard against which future budgeted programmes can be planned.

Checking Costs Forecasts

The first of these points can be achieved only by adopting a breakdown which achieves a reasonable compromise in relating influences and costs, since most cost items—and revenue rates also—are governed by a number of differing variables. Under the second objective—the checking of results against forecasts—the "indirect" or overhead costs can, to a large extent, be controlled within a budgeting period irrespective of revenue or of operating influences. This can be called "overhead control." The "direct" or variable costs can be controlled within a budget in relation to revenue and to the operating results. That may be called "route control." So, for initial planning in any budgeting period, the questions which have to be answered are:

(1) What capacity ton-miles will need to be operated to achieve the number of revenue load ton-miles estimated to be saleable?
(2) What aircraft fleet will be available and what are its standing charges—depreciation, insurance and interest on the capital involved?
(3) What airline overheads are appropriate to the scale of effort necessary to provide the capacity ton-miles required?
(4) How many revenue flying hours are involved by various types of aircraft to satisfy the programme?
(5) What are the variable flying costs associated with the flying to be done?
(6) What revenue can be gained from the load ton-miles which are budgeted? And, from that, what is the profit or loss account on budget?

These questions automatically require a breakdown of costs into the two parts, which I have called: (*a*) *Basic* (i.e., the overheads) and (*b*) *Variable* (i.e., costs directly associated with the number of hours flown and the number of landings made).

The principle which comes out of all this is a true fundamental of airline economics. It is that:

(1) "The basic costs are related to the total scale of effort involved."
(2) "The variable costs are related to the hours flown and to the landings made."
(3) "The revenue is related to the miles covered."

These three match only in the specific circumstances of a particular operation. Unlike surface transport, the time and distance relationship in aviation is never constant—for any particular aircraft it is influenced by at least four other parameters: by the load

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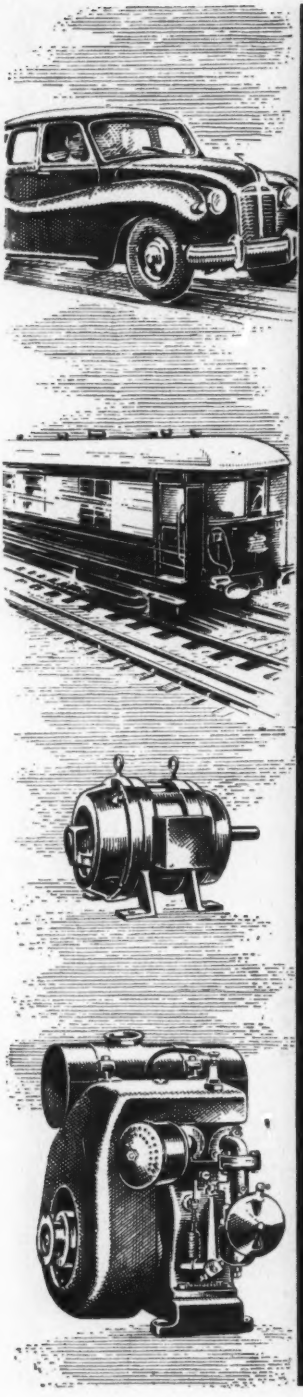

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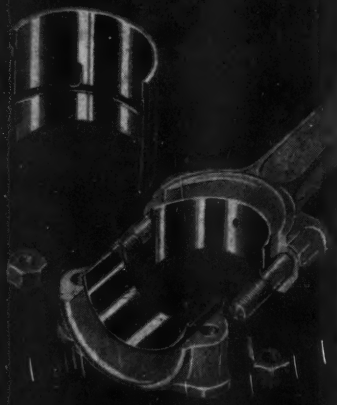

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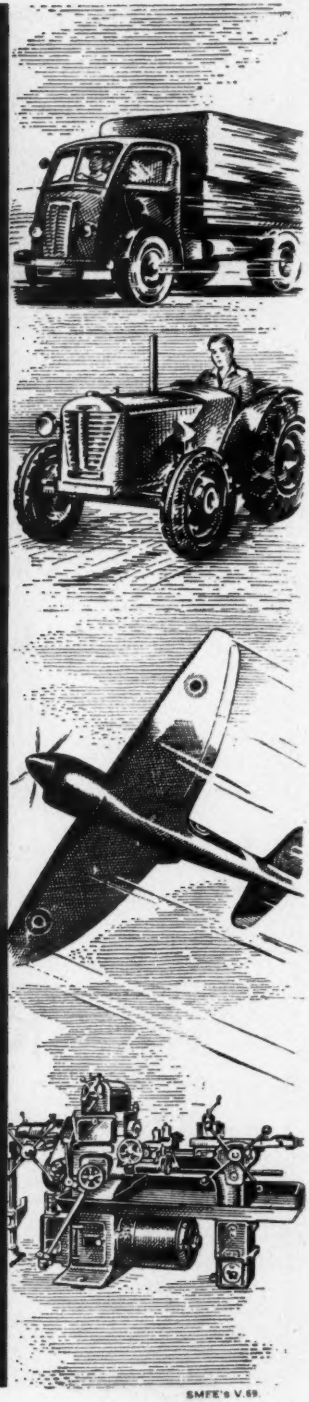

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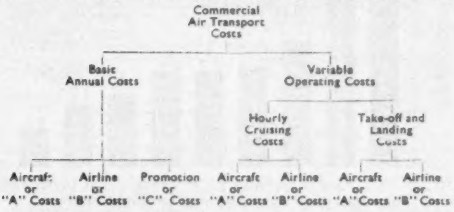
MAKING AIR TRANSPORT PAY . . .

carried, by the route distance, by the physical characteristics of the terminals (and sometimes of the terrain *en route*) and by the prevailing winds and weather.

That leads us to a "64-dollar question"—how shall we determine which costs are basic and which are variable?

In the first place, we must remember again that the underlying purpose of the cost analysis is to make possible forecasting of likely results within a budgeting period for planning—and then to assess results against the forecast for control. Incidentally, one secret of success in this is to use the "moving annual total" method, brought up to date month by month and thus showing a continuous trend of results, unaffected by seasonal variations.

TABLE II: FAMILY TREE OF AIRLINE COST RELATIONSHIPS



With this as background a number of tests can be applied to determine whether a particular cost item should be regarded as predominantly either basic or variable. A certain amount of arbitrary decision, however, is necessary to reach a clear-cut result.

We have now established that costs can be regarded either as basic or variable, whether they stem from the type of aircraft being used, from the airline organization or from the route-pattern concerned. To discover from which source they do, in fact, originate, the basic costs must be broken down under two sub-heads:

(*a*) *Aircraft Costs*—related to the size and characteristics of the aircraft used.

(*b*) *Airline Costs*—related to the organization and standards of the operator, to the location and spread of the operating pattern and to individual route characteristics.

There is one further item which has to be added—costs of a promotional character dependent on, or promoted by, the revenue requirements.

Turning next to the variable costs, we find that a similar breakdown is possible, except that in this instance promotion costs do not apply.

Under the "variable costs" heading, also, we can distinguish two further major influences—the costs incurred while cruising in the air (at an hourly rate) and those arising from each take-off and landing. The take-off and landing costs ("landing costs," for short) have an important bearing on the rates of expenditure over any route pattern because they introduce the effect of stage distance on cost.

The form and relationship of the various basic and variable costs are shown in Table II.

Going a stage further, a complete breakdown may be made of all significant items; an example is given in the application of the analysis to B.E.A.'s London-Paris route (Table III). Expenditure is broken down into three main sections, three sub-heads and 29 items and, at the same time, we can isolate the costs which are peculiar to the type of aircraft, the particular airline and the route pattern.*

For example, the "aircraft costs" under the three section-heads are all that are needed for a simple comparison of the relative merits of different types of aircraft—and, incidentally, cover in a realistic manner the objectives of the S.B.A.C. and A.T.A. formulæ.

One of the most familiar but most difficult problems in any transport business is to find a method by which overheads (the "basic annual costs") can be allocated according to operating division, route or type of vehicle concerned. The method of apportioning overheads route-by-route tends to disguise inefficiency and deter the expansion of effort within a budgeting period which, in practice, spreads the overhead costs and should improve the economic position. The same objection obtains to apportionment by flying hours.

A more logical approach is to take the common factor—i.e., the aircraft—as the basis for overhead allocation. As shown in Table III, the basic annual "airline costs" can be isolated and can be regarded as an overhead burden to be shared out and paid off over the revenue-earning units of the operator. Each aircraft can be given an apportioned weight of overheads and can then be set the task of earning enough revenue to cover not only its own variable operating costs, but also the apportioned overhead burden it is carrying. That means that as each aircraft flies it incurs accumulative variable operating costs which have to be met out of revenue before the fixed burden of overheads can be tackled and paid off.

Apportionment of costs in the "overheads" category among the various types of aircraft, however, presents a problem. If only one type were used the overheads could be apportioned by means of a direct division by the number of aircraft concerned. With a number of types, a mere numerical division would be unequitable, as would any division involving the number of hours flown, the capacity ton-miles provided or the revenue earned, because it puts a penalty on utilization—the more flying done the more the overhead cost attracted.

In fact, apportionment by gross weight of aircraft appears the

TABLE III: VIKING COSTS ON THE LONDON-PARIS ROUTE

	Viking Type Costs	Cost per Aircraft on Route	Percentage of Total Cost on Route
(I) BASIC ANNUAL COSTS:—	(£ p.a.)	(£ p.a.)	(per cent p.a.)
("A") *Aircraft Costs* :—			
(1) Obsolescence (aircraft and spares)	,154	7,154	4.49
(2) Insurance (aircraft and third party)	2,285	2,285	1.43
(3) Interest on capital sunk in aircraft and spares	1,466	1,466	0.92
("B") *Airline Costs* :—			
(4) Engineering overheads	10,138	10,138	6.38
(5) Flying-staff training (development)	1,516	1,516	0.95
(6) Station administration	7,248	7,248	4.54
(7) General administration	9,429	9,429	5.91
(8) General overheads	4,866	4,866	3.05
("C") *Promotion Costs* :—			
(9) Sales	3,980	3,980	2.50
(10) Advertising	3,174	3,174	1.99
(11) Commissions payable	7,027	7,027	4.40
Total basic annual costs per annum	£58,283	£58,283	36.56
(II) VARIABLE COSTS:—	(£ per revenue hour)	(£ p.a.)	(per cent p.a.)
(a) *HOURLY CRUISING* :—			
("A") *Aircraft Costs* :—			
(12) Flying-staff pay, allowances and pensions	6.35	12,637	7.93
(13) Stewards' pay, allowances and pensions	1.00	1,903	1.19
(14) Flying-staff training (operational)	0.13	247	0.16
(15) Fuel and oil costs	9.77	18,589	11.66
(16) Variable engineering labour costs	2.57	4,813	3.02
(17) Outside contract work	3.96	7,287	4.56
(18) Materials consumed	1.84	3,310	2.08
("B") *Airline Costs* :—			
(19) Passengers' liability insurance	0.35	628	0.39
(20) Cabin amenities	0.77	1,465	0.92
(21) Meals on aircraft (passengers)	2.48	4,719	2.96
(22) Meals on aircraft (flying staff)	—	—	—
(23) Meals on aircraft (stewards)	—	—	—
Total hourly cruising costs	£29.22	£55,598	34.87
(b) *TAKE-OFF AND LANDING*:—	(£ per landing)	(£ p.a.)	(per cent p.a.)
("A") *Aircraft Costs* :—			
(24) Landing fees	4.68	5,733	3.60
(25) Outstation variable engineering costs	2.57	3,148	1.97
("B") *Airline Costs* :—			
(26) Meals and ground accommodation (passengers)	0.06	·73	0.04
(27) Meals and ground accommodation (flying staff)	0.55	669	0.43
(28) Meals and ground accommodation (stewards)	0.16	200	0.13
(29) Variable station costs	29.15	35,700	22.40
Total "take-off and landing costs	£37.17	£45,523	28.57
Total Costs: per aircraft per annum			£159,404
per flying hour			£83.6
per round trip			£260.1
Variable Costs: per aircraft per annum			£101,121
per flying hour			£53.1
per round trip			£164.9

* *In an annexe to his paper, Mr. Masefield discussed methods of approach to the invidious task of showing how and why specific items can be allocated under particular headings.*

MAKING AIR TRANSPORT PAY . . .

most satisfactory solution, because it both reveals the benefits of high utilization and brings into account the efficiency of the aircraft, tending to put a bonus on efficiency. This method seems both logical and has been found to work equitably in practice.

When we come to the problem of costing individual routes and of evolving a basis for allocating to each route its fair share of the "airline costs," we can proceed from the basis we have already established. Apportionment of the basic annual airline costs is not easy but I have adopted the arbitrary and, I think logically justifiable, coefficient based on gross weight to parcel out these costs to different aircraft types. Promotion costs can be treated similarly because, budgeting ahead, they have to be assessed and then spread over the earning medium; these costs are related to the total sales effort of the airline and not to individual parts of it.

The total of these three items—aircraft, airline and promotional costs—then give the total basic annual costs to be borne by each type of aircraft.

Examination of individual routes leads to the need to apply or allocate these costs to specific operations within the broad pattern of services and to this end a logical but simple method which uses the scheduled operations as the basis for division has been evolved.

By relating the hours scheduled to be flown by the types of aircraft on a specific route to the total hours scheduled for these types on all routes, and then applying this relationship to the total basic annual costs already apportioned to the types concerned, the resultant gives a reasonable apportionment to the route. The important point is that the hours used in the calculation are only those scheduled. Thus a route on which extra traffic is operated gains an indirect incentive bonus in that the extra services attract no additional overheads—because the basic annual costs themselves have not increased. Each operating manager in charge of routes is thus encouraged to foster extra traffic without the feeling that by better utilization of personnel and equipment he will be penalized by bearing extra overheads.

Any tendency to "under-schedule" on a route—to reduce the overheads it will attract—can be eliminated at source by insisting, during budgeting, on the attainment of an acceptably high aircraft utilization—provided that at least the variable costs are being covered out of revenue. In such circumstances, the higher the utilization the better. Variable costs are apportioned to routes directly according to the hours flown and to the number of landings made on the particular route.

London-Paris Route Example

As a practical example of this method of costing I can present results gained by B.E.A. on the London-Paris route, operated with Vickers-Armstrongs Viking IB 27-passenger aircraft. The operating costs are shown in Table III, together with the percentage of the whole which each item represents.

The largest division is seen to be the basic annual costs, with 36.56 per cent of the total. Higher utilization would reduce this percentage. The biggest single item is the variable station-costs which, at Northolt and Paris, together amount to 22.4 per cent of the total costs. Next largest item is fuel and oil, with 11.66 per cent of total, followed by pay and allowances of the flying crews, amounting to 7.93 per cent. The total of all engineering costs adds up to some 18 per cent of all costs, thus putting engineering (including maintenance) in perspective as one of the major items for study in successful airline operation. The division of the proportion of costs into their major components is shown graphically in Fig. 7.

During the specific 12-month period under review, a total of 10,800 revenue-hours was scheduled to be operated by the London-Paris Vikings, amounting to 16.5 per cent—one-sixth—of the total Viking hours scheduled on all B.E.A.'s routes. The allocation of basic annual costs to Vikings is therefore 16.5 per cent of the whole and amounts to £401,500 in the period under review.

Cruising costs for Vikings work out at £29.2 per hour on the route and, as 13,106 hours were flown, they therefore amount to

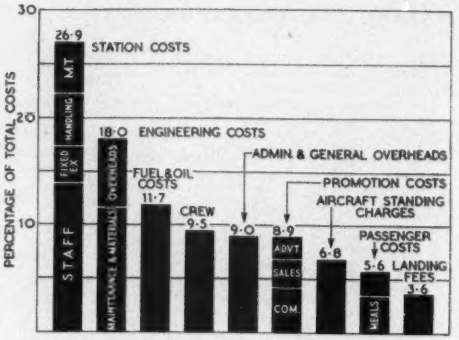


Fig. 7. Total costs of operating B.E.A. Vikings on the London-Paris route apportioned under their nine component headings.

£383,000. Landing costs on the London-Paris route total £37.2 per landing for Vikings. The 8,438 Viking landings give a total landing cost of £313,600. Thus the total costs (basic, cruising, landing) for the London-Paris route for the 12-month period add up to £1,098,100.

Revenue earned in the year was £1,106,100. Thus the route had a slim overall profit of £8,000 in the twelve months, including all overheads—representing 0.7 per cent of the turnover.

Variable operating costs (cruising costs plus landing costs) amounted to £696,600, or 63.5 per cent of the whole. Thus the contribution to B.E.A.'s overheads of the route was £409,500 in the year—the total allocated overheads (the basic annual costs) being £401,500.

Breaking down the route costs further, we get the following "total cost" results for the basic units: Per flying hour, £83.6 (revenue, £84.4); per aircraft-mile, 11.25s (11.33s); per capacity ton-mile, 45.1d (45.4d); per seat-mile, 4.59d (4.63d).

The revenue was gained from a total load-factor of 67 per cent, including passengers, excess baggage, freight and mail. The mean revenue rate per load ton-mile worked out at 67.6 pence, which compares with a passenger rate of 71.2 pence per load ton-mile. Therefore, the variable operating costs would be covered, and a contribution made to overheads on services operated at a mean *passenger* load-factor in excess of 51 per cent.

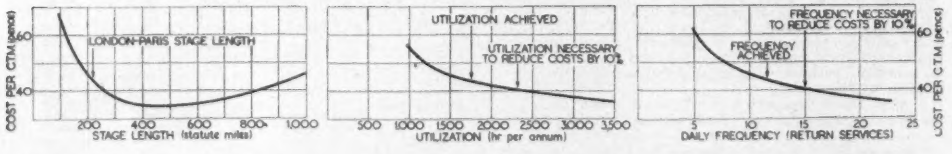
London-Paris is thus seen to be a profitable route. But it is also a high-cost route, because its total costs of 45.1 pence per c.t.m. compare with the average cost of 43.1 pence per c.t.m. of B.E.A.'s total operations; an average increased by many very-high-cost short-haul routes such as those in the Scottish Highlands.

A point which is not generally realized is that the London-Paris route had never been profitable to any operator until recent months. For a long time the revenue had covered the variable operating costs and contributed usefully to overheads, but the high route costs had prevented overall profits from being made. The reasons why the route is expensive to operate are that the short sector-distance causes a high incidence of landing costs and a low block-speed (comparatively few revenue ton-miles are flown in an hour); the Paris handling costs are high; a meal has to be provided every 215 miles; and crew-utilization is low because of the high proportion of turn-rounds.

New and larger aircraft, such as the Elizabethan, will substantially improve results once they are fully "run in" on the route, because of their lower variable operating costs. However, a high utilization will be essential to keep specific costs down.

Taking the London-Paris costs as a basis, let us now examine the effect of varying some of the major influences.

Stage Length.—Keeping to the same type of aircraft, Fig. 8 shows graphically the effect on cost per c.t.m. of an increase in



Figs. 8, 9, and 10. Effects on operating cost of varying stage-length, utilization and frequency respectively (based on the London-Paris cost structure).

the stage distance. This examination shows that the Viking's specific costs fall steadily until a route-distance of 460 miles is reached, after which they start to go up because payload is falling. Revenue falls slightly with stage length and, in fact, load factor would also tend to fall, because of the increased cost of travel. (Many people can afford a £10 return fare for a 200-mile flight; not so many can afford a £40 return fare for a 1,000-mile flight, even though the rate per mile is less.)

But, assuming a constant load factor of 67 per cent and the same rate of utilization and rate of revenue, the annual profitability of the stretched-out route would become:—

London-Paris	215 miles.	Profit,	£8,000
Same cost and revenue structure	400 miles.	Profit,	£241,000
do. do.	460 miles.	Profit,	£260,000
do. do.	600 miles.	Profit,	£211,900
do. do.	800 miles.	Profit,	£136,400
do. do.	1,000 miles.	Loss,	£29,236

That means that with Vikings a route-distance of 460 miles is potentially the most profitable and would show 31.5 times the profit on the 215-mile London-Paris sector—a distance which is too short a stage for really economic results and is made attractive only by the high traffic-density.

Utilization.—Fig. 9 shows the reduction in cost per c.t.m. which results from increasing the utilization from the 1,750 hours per aircraft per annum achieved in the original London-Paris survey. The effect will be to spread the basic annual costs still more on the more expensive modern aircraft, with their higher standing charges. Nevertheless, even with Vikings, the effect of doubling the utilization is to bring the costs down by 19 per cent. Above 3,000 hours per annum, however, the effect of increased utilization is much less marked because of the disproportionately increased effort needed. Higher utilization must also mean support from increased traffic unless uncommercial hours are to be flown, with a consequential drop in load factor or a necessary decrease in fares.

Route Frequency.—The original survey was for London-Paris, operated at a mean route density of 11.5 round trips a day. Fig. 10 shows the effect of increasing the scheduled number of daily frequencies—assuming the traffic will increase *pro rata*—but keeping utilization constant. The effect is again to spread the basic annual costs associated with the route. In general, it can be said that European operations are at present at much too low a route-frequency for real economy. If the traffic is there, the effect of increasing frequency is of real importance in reducing costs.

Load Factor.—The simple effect of varying load factor is to reduce or increase revenue. Taking the original utilization, frequency and costs, the break-even load factor comes out at 66.5 per cent. An increase of 20 per cent would increase profit by 109 per cent. Costs go up slightly with increase in load factor, but the effect is small and confined chiefly to passenger handling and meals. A load factor much above 70 per cent is not a good commercial proposition on most routes, because it means that, with inevitable peak effects, traffic is being turned away at popular times—with consequent loss of goodwill.

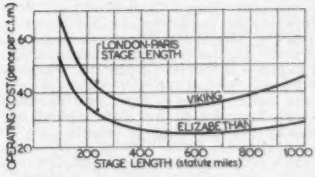


Fig. 11. Comparison of the effects of stage-length on the operating costs of B.E.A. Vikings and the new Airspeed Elizabethans.

Mail Pay.—Air-mail pay is, of course, a vital factor in airline revenue today. On the London-Paris route, B.E.A.'s results were 57,367 load ton-miles of mail flown, for which a payment of £23,550 was received, working out at 98.4 pence per l.t.m. But these were almost entirely one-way loads—from London to Paris. Space provided outbound had to be flown back empty, as practically no return mail loads were offering. Assuming an average of about 86 per cent load factor on outbound mail space, the total load factor out and back would be 43 per cent. The rate per return c.t.m. set aside for mail was therefore about 40.9 pence, which compares with the overall average rate for the route of 45.4 pence per c.t.m. or the passenger rate of 51.05 pence per c.t.m.

Thus, if the return mail rate for each c.t.m. provided were equal to the passenger rate prevailing, the rate of mail pay would have to be increased by 24.8 per cent and the profit on the route would go up by 73 per cent. There is obviously an argument for charging for mail at not less than the return passenger rate per c.t.m., so that a pound weight of mail is no less worth carrying than a pound weight of passenger—the priority given to the mail offsetting the fact that it does not eat a meal on the flight. On a less "fat" route than London-Paris the influence on the airline's results would be much more marked.

In fact, without a much more adequate return from mails, there are many internal—and highly seasonal—air routes being operated at present which can never make both ends meet financially this side of the fully developed helicopter era.

A commentary on all this is that, in 1949-50, passenger revenue amounted to 77.1 per cent of B.E.A.'s total revenue, mail to 9.9 per cent, freight to 6.9 per cent and excess baggage to 1.7 per cent.

Aircraft Type.—The costs which I have assessed have been for Vikings. Fig. 11 sets out the results if the same c.t.m.s and utilization had been provided on the route by the new Airspeed Elizabethan, which has the advantage of being of a size suitable to operate at an acceptably high frequency between London and Paris without providing too many c.t.m.s for the route. It shows that for this London-Paris operation the Viking is too small and that the Elizabethan will do much better. In fact, for the same utilization, for the same number of c.t.m.s and l.t.m.s at the same revenue rate, the Elizabethan would offer a potential profit of £265,500 on the route.

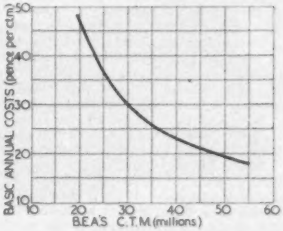


Fig. 12. Basic annual cost as affected by scale of operation (based on B.E.A. results; no attempt has been made to eliminate the effect of improving efficiency).

Airline Size.—Finally, the effect of airline size and productivity can also be assessed. Fig. 12, based on actual records, shows how B.E.A.'s basic annual costs per capacity ton-mile have fallen with an increase in the scale of operation.

The results given take account of improving efficiency, and in order to show how the basic annual costs and the basic costs per c.t.m. are likely to vary when influenced solely by the number of c.t.m.s produced per annum the effect of improved efficiency has to be eliminated.

This will indicate that, were B.E.A. halved in size, the basic costs would be likely to fall by 30 per cent, but that the specific basic costs would increase by some 40 per cent per c.t.m. The reason is that the overhead structure of B.E.A., now fairly streamlined, could not be reduced in proportion to a shrinkage in operations. Transferring these results to the London-Paris route, one might say that for an airline of half the size, but operating to the same standards, the profit of £8,000 in the twelve months reviewed might be reduced to a loss of £146,000.

Up to a point, increased size can reduce costs by spreading overheads over more revenue, but there comes a point where—because of the need for widespread duplication of function—a further increase in size results in rise in specific cost.

In view of the many other variables which influence this subject, however, all I will say at this stage is that, in the case of B.E.A., I am certain that increased efficiency and reduced operating costs are still possible with a modest increase in size and extent of operations over the present totals of 7,250 employees and 15,064 route-miles. This survey therefore shows that, of the seven influencing factors which have been considered, the most important is the matching of the aircraft type to the most appropriate stage-length—a process not always entirely within the control of the operator. Using the right aircraft over the most appropriate stage-length can improve results to a very large degree.

All this adds up to the fact that we are still a long way from reaching an optimum point in the development of commercial air transport. Effective improvements can be achieved by increases in utilization, in route frequency and in aircraft size, while a case can also be made out for increased mail pay. Equally, air transport concerns should be neither too large nor too small if the most economic results are to be gained. For that reason, I am convinced that the policy of having at least two British Airways Corporations, rather than a single "chosen instrument," is correct and leads to results superior to those which could be gained with any single organization.

The whole subject needs constant and relentless study and application. Above all, it requires an objective method of cost analysis and control which focuses attention on the vital spots.

(*To be concluded*)

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Electricity or Airways?

WITH reference to Mr. A. Jenkins's letter in the February 23rd issue of *Flight*, I too have noticed the rather confusing use of the initials "B.E.A." by two nationalized corporations.

I feel, however, that the people who so continually exhort us not to use the commodity which they so sparingly produce have a rather stronger claim to the initials on the ground that they carry the greater number of "passengers." Their continued use of the coveted letters will serve to reinforce this statement.

Thorpe Bay, Essex. J. F. M. WRIGHT.

Basic Science

IN pursuance of Truth and the welfare of newcomers to the science of aviation and in the teeth of the mathematical boffins, I feel impelled to point out a misapprehension on the part of the writers of elementary textbooks dealing with aeronautics. The same mistake occurs in school science-books.

In treating of gravitation it is frequently stated that "the force of gravity increases the nearer the centre of the earth is approached." And from this statement it is inferred that, the nearer one approaches the poles, the greater is the acceleration due to gravity, because one is getting nearer to the centre of the earth.

Now it is true that g increases as the poles are approached, but it is not because the centre of the earth is nearer. In any case, the force of gravity would be nil at the centre of the earth.

The truth is that g decreases towards the equator owing to the earth's spin and the consequent increase of centrifugal force with decreasing latitude. If the great big world turned seventeen times as fast as it does, objects at latitude 0 degrees would whizz off into space. Furthermore, if the earth did not revolve at all, objects would weigh more heavily at the equator than at the poles.

Hamble, Hants. LESLIE W. CRAWFORD.

Check Flights

I REGRET that Dr. Noel Jackson, in a letter published in your issue of February 15th, should so seriously have misquoted the "Civil Aviation News" item referring to check flights in your issue of January 18th. I am not concerned with the subject-matter of his letter so much as with the grave injustice done to the chairman of this Association, Capt. Upton, who is quoted as saying, "An aircraft captain should never be required to subject himself to check flights which . . . tend to undermine the captain's confidence in himself and endanger the discipline in the aircraft." If Mr. Jackson will read your news item again he will see that it was *not* Capt. Upton who said any such thing, but a correspondent who was disagreeing with what Capt. Upton had written in the December issue of *The Log*, the official journal of the British Air Line Pilots Association.

It is regrettable, to say the least, that Capt. Upton should have been publicly associated with remarks which he never made and to which in effect he is thoroughly opposed. I suggest that Dr. Jackson reads your articles a little more carefully in future.

London, W.1. D. FOLLOWS,
Secretary, British Air Line Pilots Association.

[The letter in question should, of course, have been amended before publication to make the origin of the statement clear.—ED.]

Fireproof Mosquito

I WAS interested to see on page 186 of your issue of February 15th the picture of a Mosquito "which came home after flying through blazing fuel from its victim." I was the pilot on that occasion, the night of August 7th/8th, 1944. We were on a routine night-fighter patrol over the Normandy beach-head, and, though we did not reach our base at Hunsdon, we did make a safe landing at a strip on the other side—B.5, near Caen, commanded by G/C. C. S. Morice, who was probably indirectly responsible for the photograph.

Should any readers be interested, here are some details of the incident. We had intercepted a Ju 88 over the beach-head on a very dark night and I had difficulty in seeing it through the ring-sight before opening fire. Two bursts of cannon produced no impression beyond awakening the crew of the "88," who evinced a certain apprehension by taking violent evasive action. Visual contact was lost, but skilful work by my operator, F/O. A. C. Willmott, D.F.C., enabled us to follow by A.I. until the Ju 88 over-optimistically stopped weaving. This time, fire was opened from a much shorter range and one of the petrol tanks blew up in a sheet of flame, which we could not avoid flying through. Passage through the flame was instantaneous, and no undue heat or smell of frying was detected in the cockpit; but on emerging the other side I found myself blinded and unable to see any flying instruments. This was unfortunate, as we had pulled away steeply in trying to avoid the flames. I knew instinctively what the legendary man in the cloud "with nothing but SMITHS on the clock" must have felt like, though my operator's torch saved us before we became genuinely inverted.

I had no idea how badly the aircraft was damaged, though the twitching of the rudder-bar at my feet showed that something was adrift in that direction. From what one reads it was customary on occasions such as this to "press on" back to base and make an impressive *entrée* with a tattered aircraft at one's home airfield, but I was too worried, about what might happen next, to remember this; I therefore asked to land at the nearest strip in Normandy. This was accomplished with some difficulty, at the second shot, as the entire windscreen and Perspex cockpit canopy was charred black, which ruined the visibility and caused us to miss the first approach. In addition, both wings had been damaged by debris from the e/a, and a large panel had disappeared from the upper surface of the port one. I must admit, however—and I take off my hat to de Havilland's—that nothing in the behaviour of the aircraft after the incident suggested that the damage was as extensive as it proved to be. In fact, I can thoroughly recommend rudderless night-flying in Mosquitoes as a useful exercise for pupils at night-fighter O.T.U.s!

Southborough, Kent. M. M. DAVISON.

Those Veterans

THE article by A. Cdre. Wheeler, "Not unfair to Veterans" (February 8th) should receive the courtesy of a reply, though there is very little which requires an answer.

The gist of my own article (December 21st) was that a mid-way course was being pursued in the exhibition of the veteran aircraft, which I deprecated, and that the commentaries were silly—to put it mildly.

Now A. Cdre. Wheeler has kindly confirmed my suggestion regarding the policy and assured us that the commentaries are far more mild than at the Cleveland Air Races; as regards the latter, I only hope we may be spared the necessity for catering for the lowest intelligence to which the American commentators seem to pander.

So the "proverbial cigarette smoke going (nearly) straight up" has to come into it! One of the dear old "string" legends!

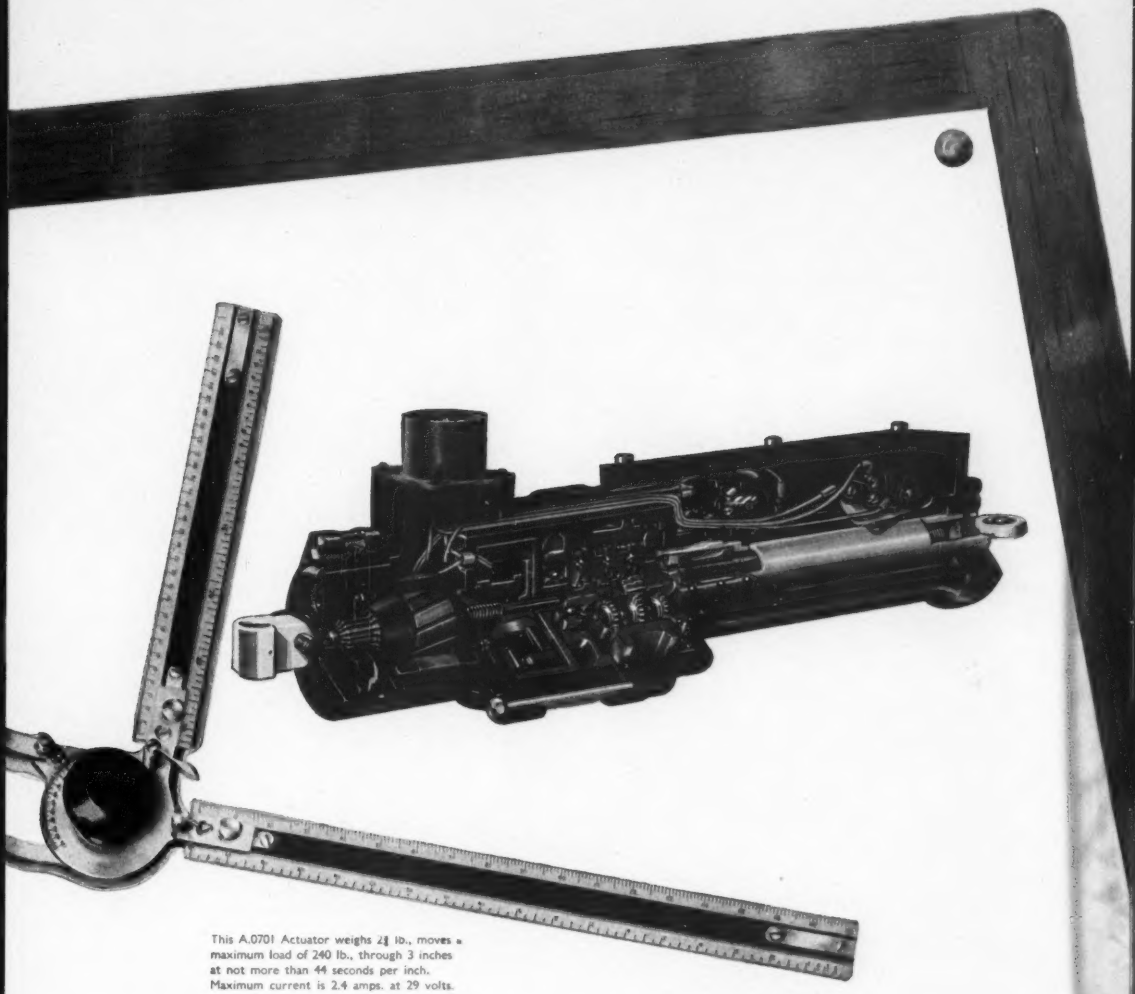
In a constructive criticism of my article a correspondent (January 18th) mentioned, correctly, that the Dep. flew from Hendon to Brooklands in a 40-55 m.p.h. gale in 1913. This was not an everyday occurrence, but it was certainly not unique. I am no pioneer, but I do remember flying a Grahame-White "Box-kite" (an aircraft without cockpit or instruments, but fun to fly and a contemporary of the Dep.), the length of an airfield *backwards*. At the time I assumed that it was due to a wind and have, in fact, used that and similar incidents in efforts to explain the mysteries of the terms "air speed" and "ground speed" to pupils. People should realize that the danger in those days occurred when aircraft were taxying—for then, due to their light loading, one had only to get slightly cross-wind for things to happen.

It is interesting to note, from A. Cdre. Wheeler's article, that the veteran aircraft which could only have been grounded in a "cigarette" wind merely took a "poor view" of a Meteor's slipstream.

I claim at least as much respect for the pioneer aircraft as does A. Cdre. Wheeler, and I have a deep regard for the late Richard Shuttleworth and the Trust, to whose excellent work this country owes a big debt. I am quite sure that, in veteran demonstrations, the air commodore has tried to avoid "any suggestion of the comic"; but it is my point that the mid-way policy encourages that effect—and at White Waltham in 1949, for example, it was certainly achieved. He should not think that the views I expressed were by any means mine alone; there and elsewhere, I mixed with spectators and heard opinions.

In the gallant air commodore's last paragraph it seems that he is extending his benevolence to veterans/human as well as veterans/aircraft, which is very decent of him. So to amuse him, perhaps, I should add that, in mitigation of my crime of "getting on," I have not only a first-hand knowledge of the old aircraft, but during my "quiet though still gently active old age," I have been in various "glass cases" and, within the last year, spent some time in one at 40,000ft.

Potters Bar, Middx. A. H. CURTIS.



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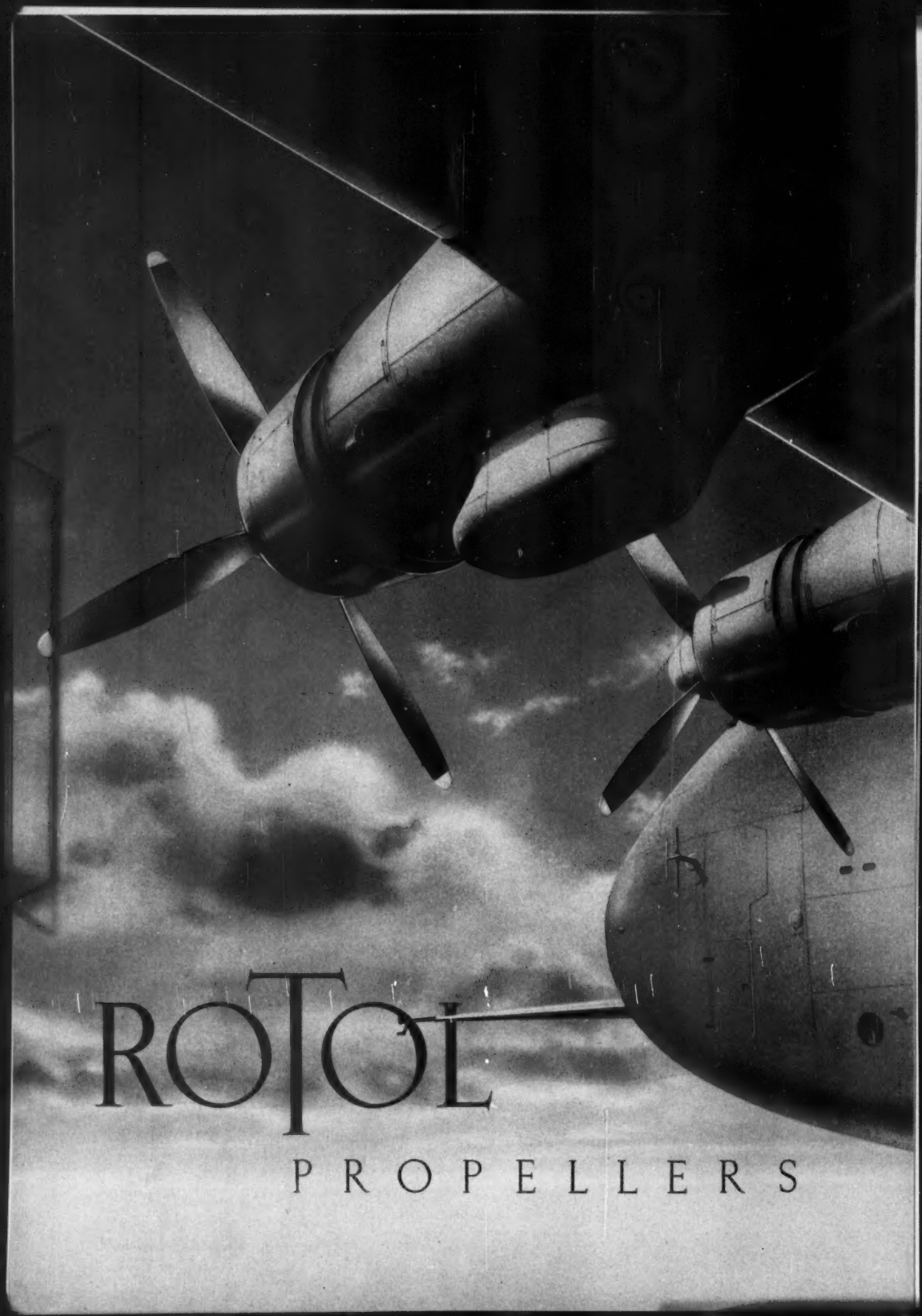

ROTOL
PROPELLERS

SERVICE AVIATION

Royal Air Force and Naval Aviation News

"Flight" photograph

WEATHER SHIP: A Handley Page Hastings of a Coastal Command meteorological squadron prepares to take off from Aldergrove for a weather-reconnaissance over the Atlantic.

A "CONSIDERABLE increase" has been made in the order placed by the Canadian Government with Canadair, Ltd., for F-86 Sabre jet fighters. The original order was for 100 aircraft to re-equip the R.C.A.F. day-fighter squadrons. The production-increase, it is reported, may result in allocation of Canadian-built Sabres to the R.A.F. Sabres now being produced by Canadair at Montreal are of the latest F-36E type.

Jet re-equipment is also under way in Australia, where the Air Minister, Mr. White, stated recently that the R.A.A.F. would be operating 100 jet fighters by the end of this year. This total includes Australian-built D.H. Vampires and 36 Gloster Meteor 8s recently ordered from Britain. The first Australian squadron to receive Meteors will be No. 77, now flying Mustangs in Korea.

New Singapore-Japan Service

EMPLOYING Handley Page Hastings, Transport Command has opened a new shuttle service between Singapore and Iwakuni, Japan, *via* Manila. The aircraft carry freight and passengers into Japan and return as ambulances with battle-casualties from Korea. The new service operates once a week, supplementing the existing twice-weekly Dakota service of the Far East Air Force.

At Singapore, the casualties, with any other patients requiring treatment in Great Britain, are transferred to ambulance aircraft on the Transport Command Far Eastern trunk route. In addition to British casualties, the ambulance service has brought back wounded from the French, Netherlands, Greek and Turkish contingents of the United Nations force in Korea.

Jump in the Lake

AN officer from the R.A.F.'s No. 1 Parachute School at Abingdon, Berks, S/L. J. R. W. Blyth, A.F.C., made his 1,029th parachute jump when he took part in the trials of new airborne life-saving devices in the Great Bitter Lake, Suez Canal Zone. The tests were held in the warmer climate rather than in wintry conditions in England; S/L. Blyth was among a party of Navy, Army and Air Force personnel who had been flown from the Army Airborne Transport Training and Development Centre at Abingdon to test for the first time a new composite parachute-lifejacket and other new life-saving devices for wartime parachutists.

The parachutists made their jumps into the Great Bitter Lake from the Dakota which had flown them from England. Each man carried 20 lb of sand to represent the weight of a pack and rifle and entered the water with hardly a splash. Their canopies at once heeled leisurely over on to the water and the parachutists were quickly bobbing on the surface of the lake in inflated "armchairs," awaiting the arrival of the launches that raced out to pick them up. Supervising the operation was W/C. F. C. Griffiths, D.F.C., A.F.C., commanding officer of the Flying Wing at Abingdon.

Charity At Home

RECEIPTS from car parks, collections and programmes during the "At Home" day on September 16th last year, when over 60 R.A.F. stations were open to the public, produced £13,625 for R.A.F. charities. The money has been divided equally between the R.A.F. Benevolent Fund and the R.A.F. Association. This year the open day will be Saturday, September 15th; Battle of Britain Week is from September 10-16th.

Services Rugby Football

PLAYING with a depleted team—absentees included the captain, S/L. R. H. G. Weighill—the R.A.F. lost their fifth match in succession when Cambridge University defeated them by 14 points to 3 in an open game at Halton last week.

The R.A.F.'s try came from an energetic new halves partnership, G. Morgan finding a gap near the scrum and G. A. Phillips receiving his pass to score. On Saturday, the R.A.F. also lost (6-11) to Coventry.

The Royal Navy meet a strong Army team at Twickenham on March 3rd in the Inter-Services Tournament, second round.

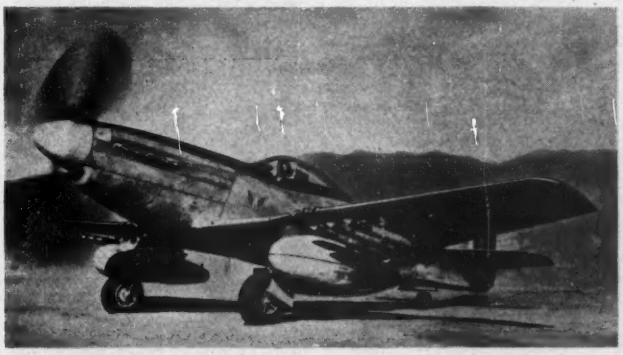
R.A.F. Appointments

AN exchange of appointments is announced between A. Cdre. H. W. Heslop, C.B., O.B.E., Director of Aeronautical Inspection Services at the Air Ministry since 1947, and A. Cdre. J. F. Titmas, C.B., C.B.E., Senior Technical Staff Officer at Bomber Command H.Q. from March, 1949. The exchange will take effect early in April.

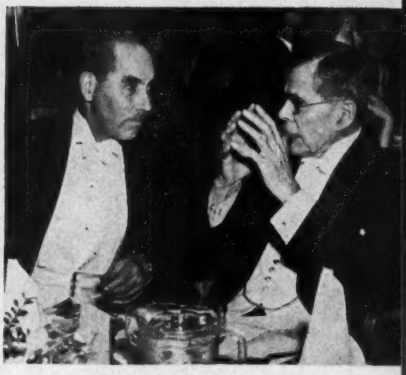
A. Cdre. W. A. Opie, Senior Technical Staff Officer at H.Q., Far East Air Force, since December, 1948, has been appointed to command the Far East Maintenance Base at Seletar from April next. His successor at F.E.A.F. Headquarters will be A. Cdre. G. B. Beardsworth, C.B., who has been Senior Technical Staff Officer, Fighter Command, since March, 1949.

Esher Trophy Awarded

THE Esher Efficiency Challenge Trophy for 1951 has been won by No. 603 (City of Edinburgh) Squadron with 458.2 points out of a possible 475. Marks are awarded to R.Aux.A.F. fighter squadrons, which compete annually for the Trophy,



SPRINGBOK MUSTANG: Armed to the wing-tips with six rockets, two napalm bombs and 1,500 rounds of 0.50in ammunition, a Mustang of No. 2 (Flying Cheetahs) Squadron, South African Air Force, is seen prepared for a strike in Korea.



SERVICE AND INDUSTRY represented at the R.A.F. Reserves Club Ball at Grosvenor House on Saturday last (see page 249). On the right, Marshal of the R.A.F. Lord Trenchard and Air Chief Marshal Sir Guy Garrod. Left: Mrs. Murphy, Mrs. Anderson and Mrs. Neville Duke hold court at the Hawker table, with Mr. George Anderson (sales manager), Mr. Neville Spriggs (works director), Mr. Frank Murphy (chief production test pilot) Mr. Michael Golovine (sales director, Armstrong Siddeley), and S/L. Neville Duke (experimental test pilot) in attendance.

SERVICE AVIATION . . .

under six headings: instrument ratings; weapons training; number of operationally trained pilots; effective flying hours; attendance; and ground training.

No. 603 Squadron has won the Trophy once before—in 1938, the last year of pre-war contest. The 1949 winner was 604 (County of Middlesex) Squadron, which gained second place in the 1950 contest. Third position was taken by 616 (South Yorks.) Squadron.

The winning squadron flies Spitfires and is based at Turnhouse. Its present C.O. is S/L. P. J. Anson, D.F.C., but for the greater part of 1950 it was commanded by S/L. J. W. E. Holmes, D.F.C.

Cadets' Flying Scholarships

SIXTY cadets of the A.T.C. and of the R.A.F. section of the Combined Cadet Force attended the February selection board for the award of flying scholarships at Headquarters, R.A.F. Home Command. Fifty-four were successful and will begin their flying training at civil flying clubs within the next few weeks.

To date, 244 flying scholarships—each valued at £150—have been granted, and already 77 cadets have gained their Private Pilot's Licences. Another selection board will meet in about a month.

Instructors Wanted

THE Air Ministry hopes that 200 volunteers will be found in the R.A.F.V.R. to act as flying instructors for 18-month periods. Recall will become compulsory if there are insufficient volunteers. Letters now being circulated to the V.R. and regular reserves point out that, under this scheme, pilots may volunteer for longer than 18 months, thereby becoming eligible for short-service gratuities—varying from £125 a year for a three-year engagement to a total of £1,500 for eight years' service.

R.A.F.A. in Paris

THE opening in Paris, on Saturday, February 24th, of the first continental office of the Royal Air Forces Association profited by the presence of high officers of the R.A.F., including Sir John Slessor, Chief of the Air Staff, and became a function of most happy augury.

Describing the ceremony, a correspondent writes: The incomparable, and indeed almost irreplaceable, Air Attaché, A.V-M. "Bobby" George, was in charge of proceedings, being nobly supported by the Marquis d'Amodio, chairman of the European Committee of the R.A.F.A. The main speech came from Sir John Slessor, who, in opening the headquarters, spoke movingly of the long connection between French and British aviators.

A reply, in English, was made by Col. Livry Lebel, now a Deputy but once, for four years, in Coastal Command as a navigator—a class he facetiously described as "half a pilot." Col. Lebel, with Gascon charm, expressed the hope that the Britjsh would always regard France as their second country, and Paris as their second city. Sir Richard Peck made a reply in French, and the fashionable party then attended to the *vin d'honneur* suitable for such an occasion. In the throng were many happy reunions, and the entente was cemented with much cordiality and practically no cordials. The office of the R.A.F.A. is now established at 12, Rond-Point des Champs-Elysées, Paris (8e).

History Revised

THE attack on Rommel's staff car in July, 1944, originally credited to Typhoons of No. 193 Squadron, which severely injured the German general and killed members of his staff, is now thought to have been made by Spitfires of No. 602 Squadron. This re-assessment was made in the light of a statement by General Sneidel, Rommel's Chief of Staff in the Afrika Korps, giving the exact time and place of the attack, which was made on the afternoon of July 19th, 30 miles south of Caen.

For the film version of Rommel's life, now being made in France, No. 602 (City of Glasgow) Squadron, R.Aux.A.F., were asked to supply pilots and aircraft to re-enact the incident. The squadron has, however, recently been re-equipped with Vampires and the part will probably be played by Spitfires from the Central Gunnery School.

Naming Naval Barracks

DORMITORIES at the Royal Naval Air Station at St. Merryn, Padstow, have been given the names of types of aircraft manufactured by eleven British and American firms and flown by the Royal Navy. Quarters at Naval establishments are usually named after famous admirals—Nelson, Rodney, Anson, Blake and Collingwood are the most popular choices—and only rarely in the past have the names of aircraft been used in this way. Ranging alphabetically from Albacore and Barracuda to Vampire and Walrus, the names of 40-odd aircraft, some still in operational use by the Air Branch, and others which have now been superseded, have been selected.

Strength of the Reserves

FIGURES showing the personnel strength of the reserve and auxiliary forces on December 31st, 1950, were published by the Ministry of Defence last week. The strength of the R.Aux.A.F. was 7,720, that of the R.A.F.V.R. 10,433, and the R.O.C. had 16,038 members. Volunteers for the R.Aux.A.F., R.A.F.V.R. and R.O.C. during the fourth quarter of 1950 were, respectively, 1,043, 1,202 and 1,388.

"Eagle" Inspected

NOW nearing completion in Liverpool, the 36,800-ton fleet carrier *Eagle* was inspected by the Third Sea Lord and Controller of the Navy, Vice-Admiral Sir Michael Denny, K.C.B., C.B.E., D.S.O., on February 23rd. Later the same day he toured the Birkenhead yard of Cammel Laird, where the *Eagle's* sister ship, H.M.S. *Ark Royal*, is being built. During his visit to Liverpool, Sir Michael Denny was accompanied by the Director of Naval Construction, Sir Charles Lillicrap, K.C.B., M.B.E., M.I.M.A.

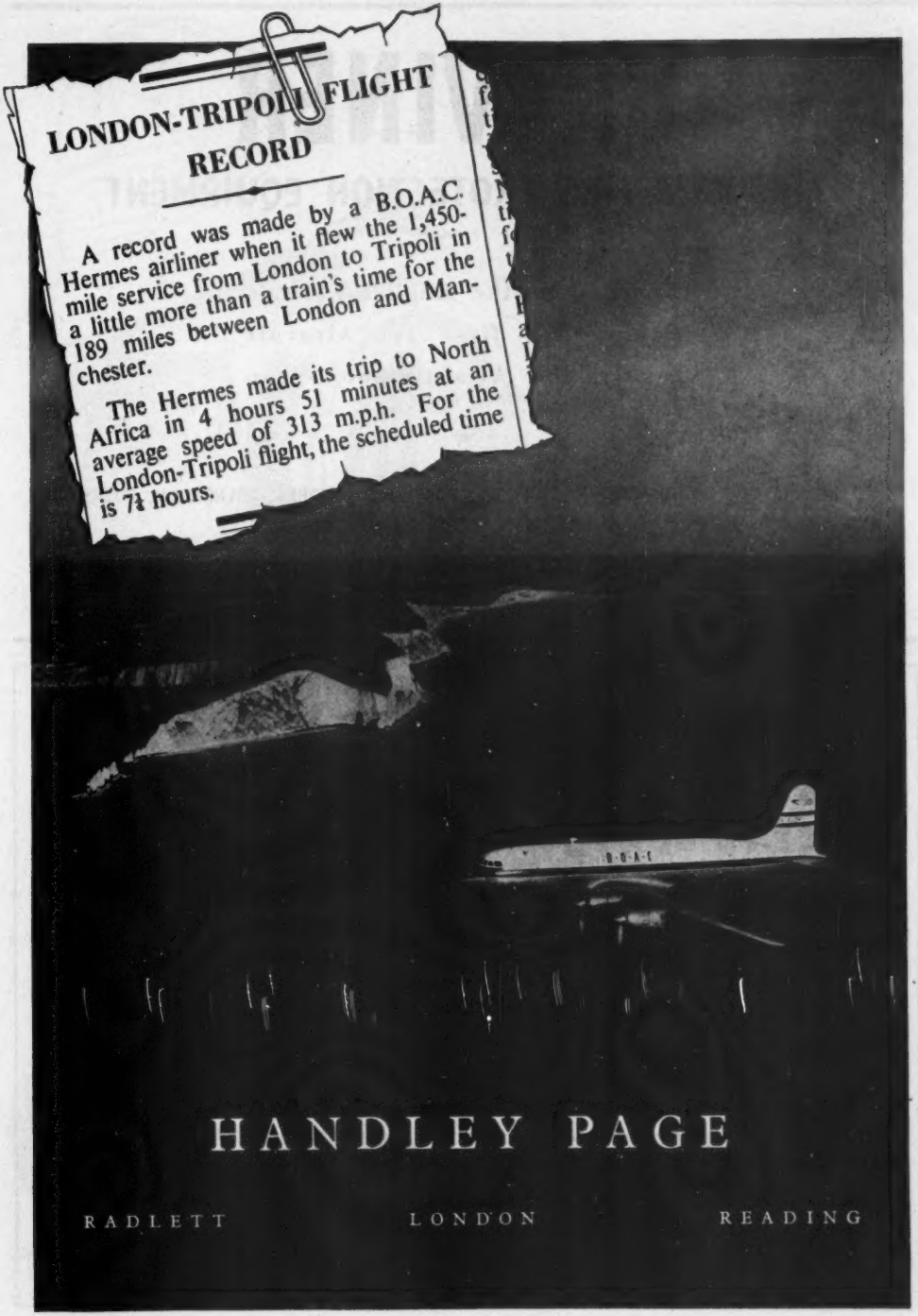
As a member of the Board of Admiralty, Admiral Denny is responsible for the construction, equipment and repair of ships, as well as research and development. The *Eagle*—at present in dry dock—was launched by Princess Elizabeth at Harland and Wolff's shipyard, Belfast, in 1946.

Reunions

NO. 524 Squadron.—Reunion on Saturday, March 17th, at 1830 hr, at the Clarence Hotel, Whitehall, London, S.W.1. Details from B. Haller, c/o J. F. Haller and Co., Land of Green Ginger, Hull.

* * *

No. 221 Squadron.—Fifth annual reunion on April 14th at the Surrey Hotel, Surrey Street, Strand, London, W.C.1. Details from H. N. Crawshaw, 93, Nightingale Road, Carshalton, Surrey.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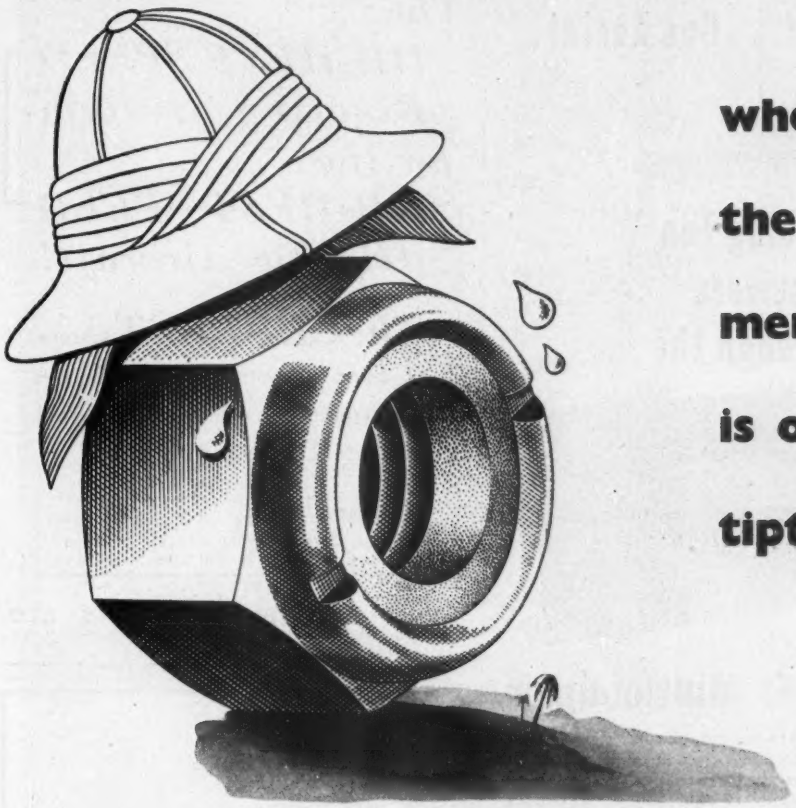

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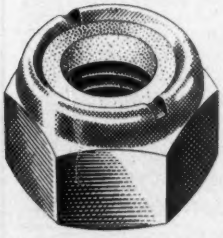

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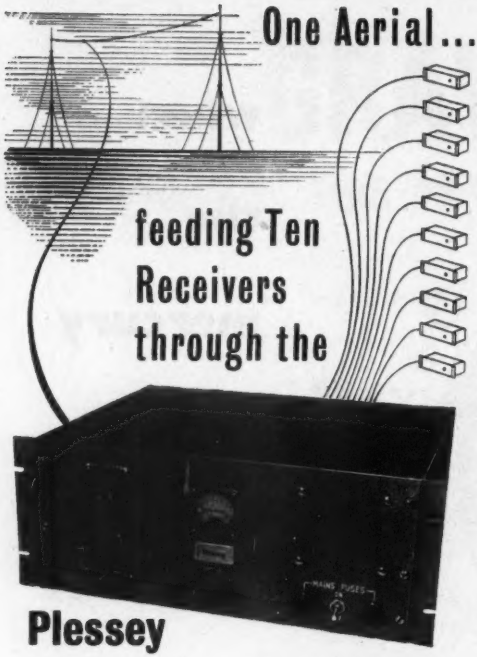

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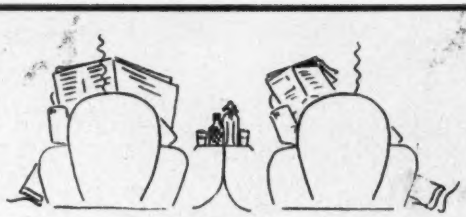

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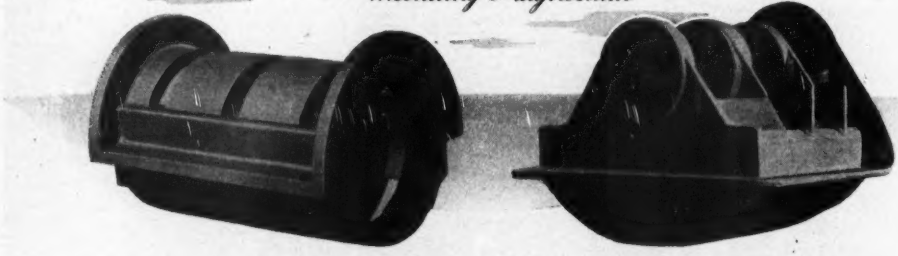

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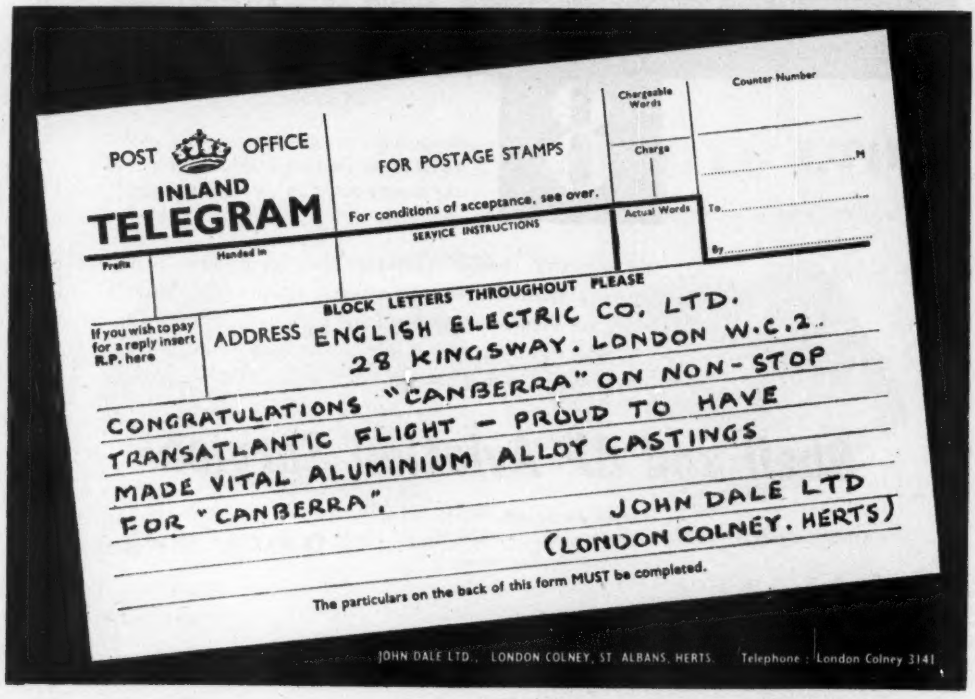

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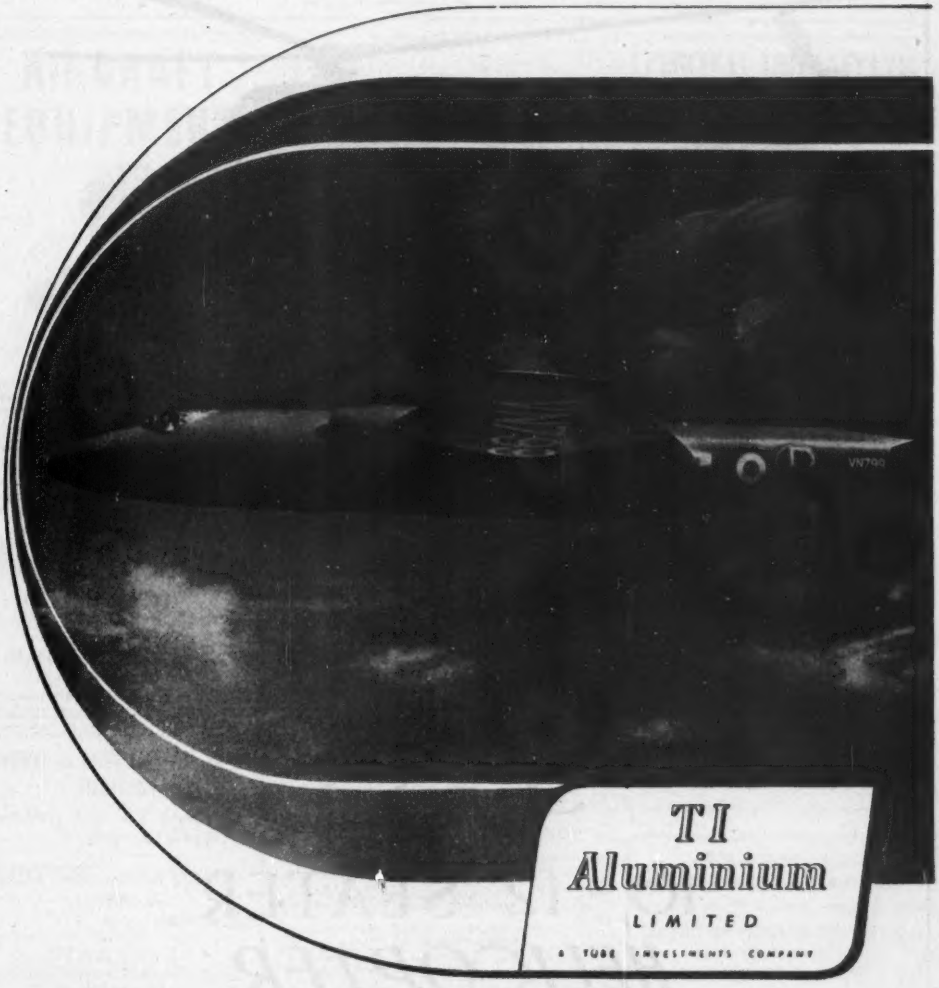

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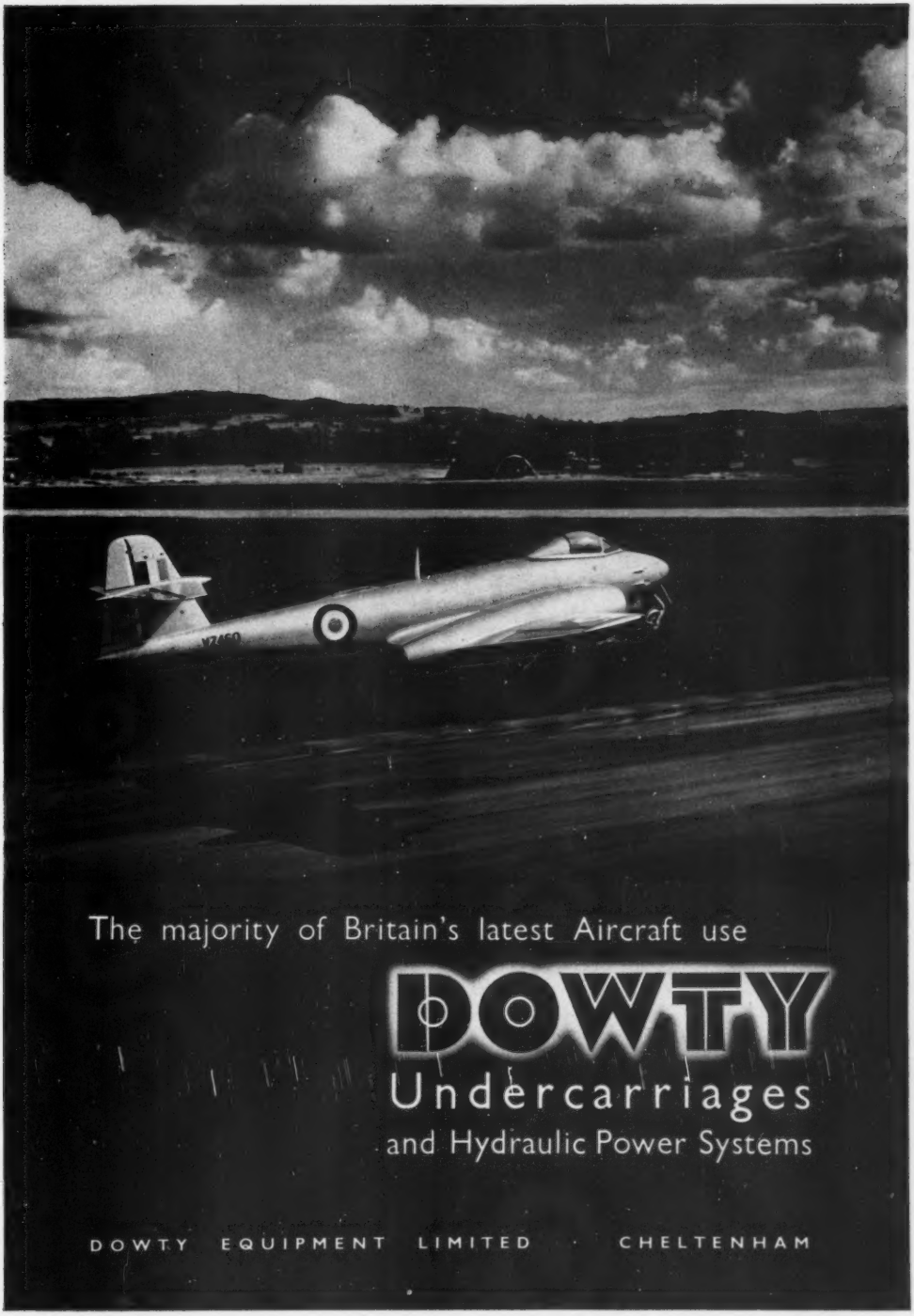
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OPERATION "AIR BEEF"

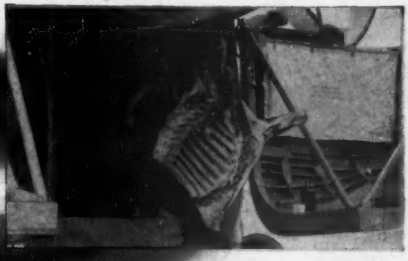
A PIONEER VENTURE IN NORTH AUSTRALIA

In September, a "Bristol" Freighter completed its first season of operation on the Australian "Air Beef" scheme. In five months of intensive activity, the aircraft carried a total of over

2,000,000 lb. of beef

Twice a day, the Freighter took off from Glenroy [illegible] six tons of chilled beef for Wyndham, the return journey [illegible] and back-loaded operating supplies, livestock, equipment and mail. In all, over 80,000 miles were

flown by "Bristol" Freighter

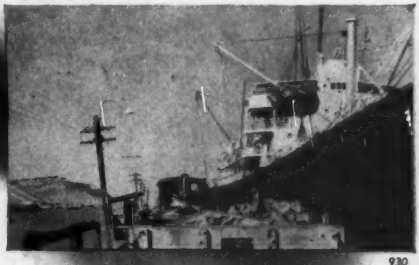


[illegible]s are desperately needed in Northern Australia, but to build roads or railways would cost millions of pounds. The solution lies with air transport, for airfields can be built cheaply. The Freighter, in fact, operated at Glenroy

from a £100 airfield

The "Bristol" Freighter has shown that the severe losses incurred in driving cattle overland to coastal killing centres can be eliminated, and "Air Beef" has given proof of its potential value by raising both the quantity and quality of meat produced in Northern Australia

for shipment overseas



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